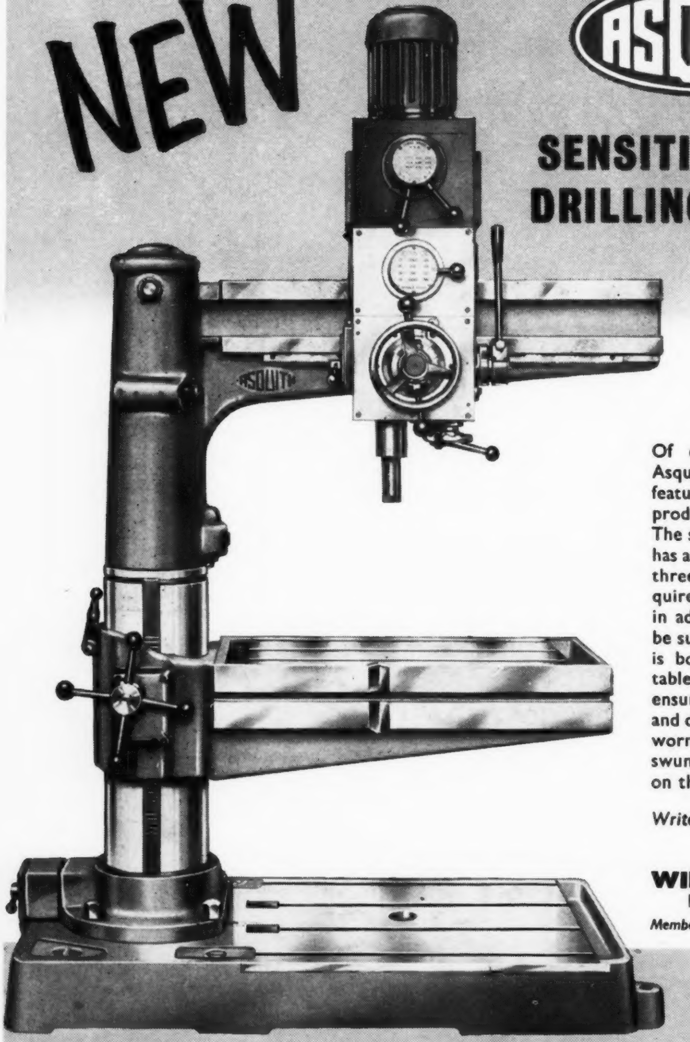
MACHINERY

SEPTEMBER 20, 1961 ONE SHILLING & THREEPENCE

NEW

ASQUITH

SENSITIVE RADIAL DRILLING MACHINE



Of completely new design, this Asquith Radial incorporates many features that contribute to higher productivity.

The spindle, of self-contained design, has a range of nine spindle speeds (in three alternative ranges) and, if required, a slide with four power feeds in addition to the sensitive feed can be supplied as an extra. The spindle is bored No. 3 Morse Taper. The table has a long bearing on the pillar, ensuring rigidity and is adjustable up and down by rack and pinion through worm gearing. This table can be swung away for mounting large work on the baseplate.

Write today for full details

WILLIAM ASQUITH LTD.
HALIFAX · ENGLAND
Member of the Asquith Machine Tool Corporation

Built in a range of sizes with maximum radius 32 in., 40 in. or 48 in.

Sales and Service for the British Isles

DRUMMOND-ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922*

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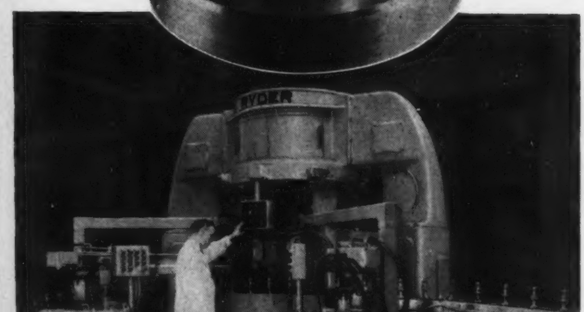
One Vauxhall cluster gear blank handled automatically and machined for gear cutting every 45 seconds!

Ryder

does it this way . . .



At Vauxhall Motors Ltd., Luton, a RYDER 8-station No. 10 Verticalauto completes all exterior machining of cluster gear blanks automatically in two distinct sequences. The two loading arms work simultaneously, lifting the components from the conveyor and returning them on completion of each stage. Here is all the speed, precision and control associated with special equipment–achieved on a standard machine fitted with auto loading and unloading. The versatile No. 10 Verticalauto, with its great work capacity and ability to reduce labour costs can surely solve a production problem for you. Six-spindle and twin-six-spindle models are also available and are equally flexible in their adaptability.

THOMAS RYDER & SON LIMITED,
TURNER BRIDGE WORKS,
BOLTON, ENGLAND.

See Ryder about automatics and auto-handling

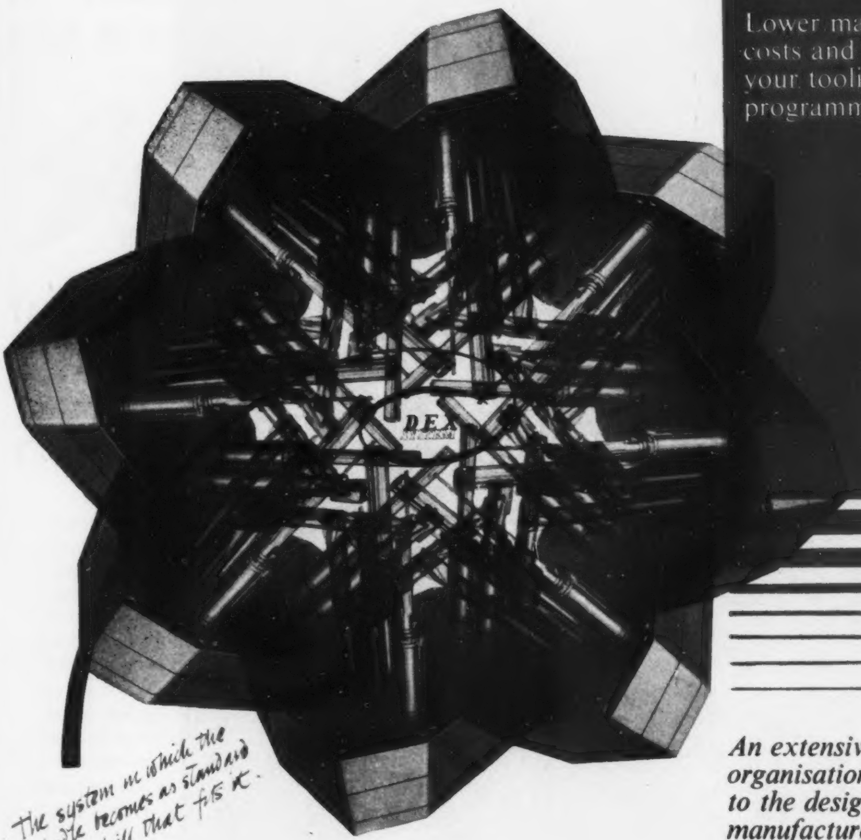
DEX SYSTEM multi drilling gives Multi-Head standardization

Off the shelf service for standard parts

Savings in drawing office time

Lower manufacturing costs and speeds up your tooling programmes.

Multi Drilling



The system in which the spindle becomes as standard as the drill that fits it.

An extensive organisation devoted to the design and manufacture of multi drilling equipment.

Designex (Coventry) Limited,

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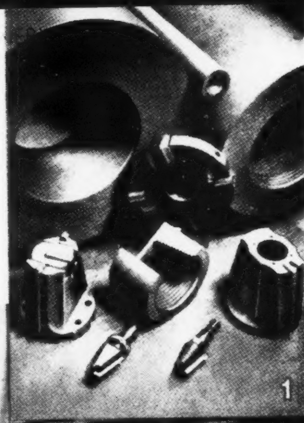

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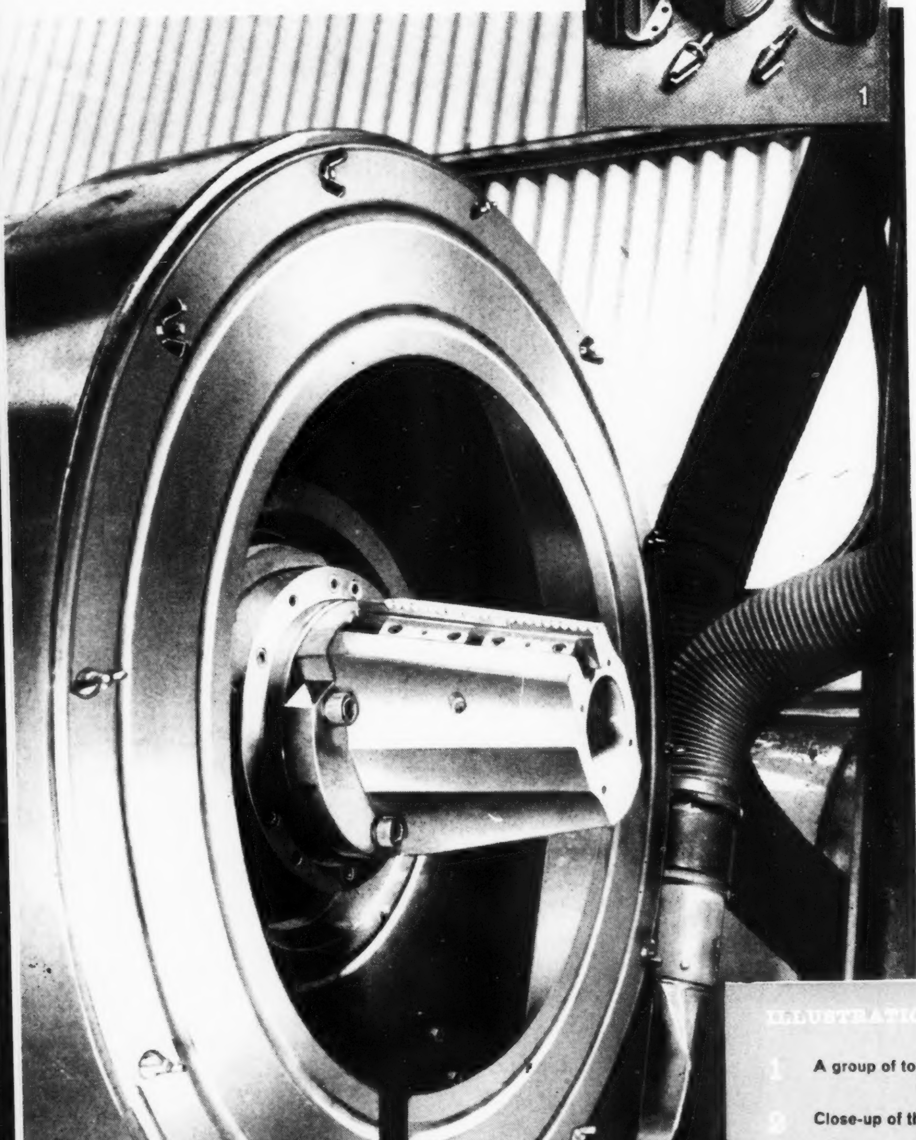

2

ILLUSTRATIONS

1. **A group of tools and components.**
2. **Close-up of thread milling cutter.**
3. **Close-up of tools on machine for taper boring and facing operation.**
4. **This picture shows the two machines ready for use—on the right hand machine the component is shown.**

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improved results by use of Purolator filters

In drawing $\frac{3}{4}''$ tubing for refrigerators Accles & Pollock use a specially developed oil in the drawing head.

Purolator bulk filters remove the scale and other abrasives from the oil, and effect a considerable saving in the operations involved.

In circle: The Purolator filter.

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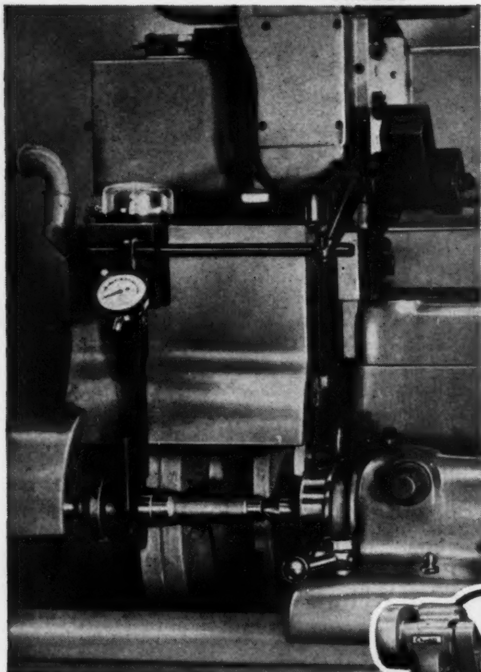

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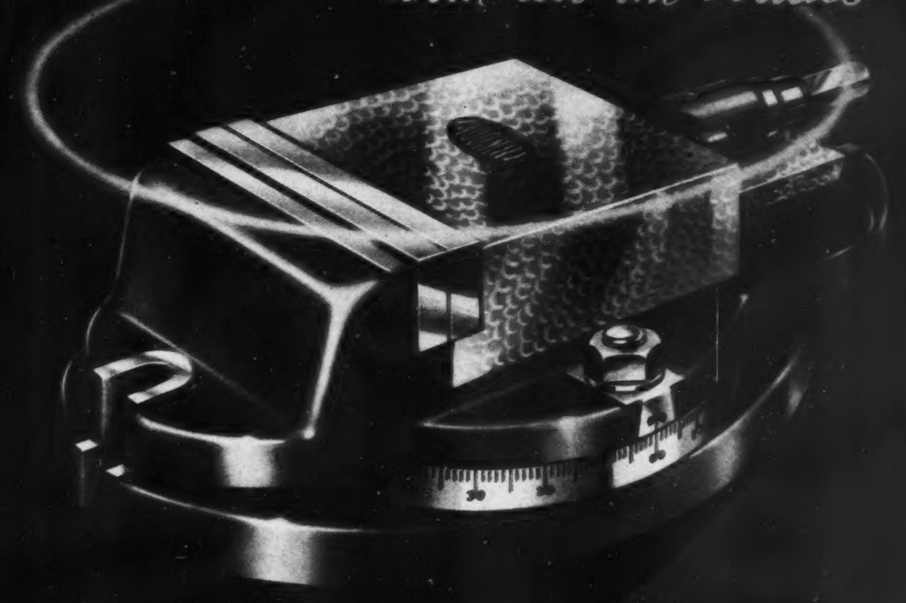
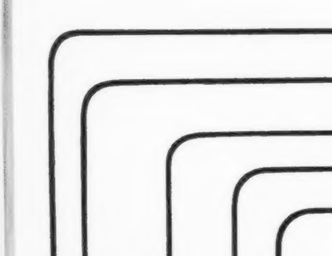
with all the virtues



THE TOOLROOM & PRODUCTION   NO TRAPS FOR SWARF, LOW HEIGHT WITH RIGIDIT



- V SLIDES ADJUSTABLE FOR WEAR. LONG BEARING SURFACES. IMPOSSIBLE FOR THE JAW TO LIFT AND TILT THE JOB.
- TOTALLY ENCLOSED SCREW WHICH CANNOT BECOME SEIZED OR BRUISED.
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- GROUND TOOL STEEL JAWS AND PHOSPHOR BRONZE NUT
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ABWOOD MACHINE TOOLS LIMITED

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BOTH spindles cutting SIMULTANEOUSLY for maximum efficiency

DOUBLE ENDED
HEAVY DUTY
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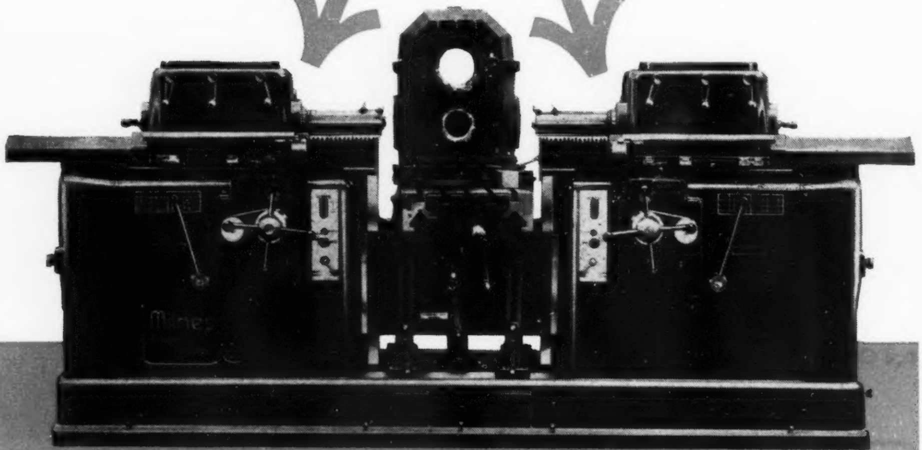

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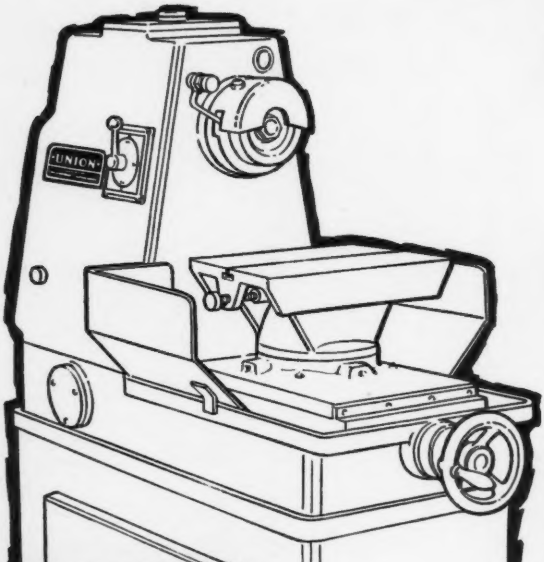

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LAPPING AND CHIPBREAKER GRINDING MACHINE

Lapping carbide tools after grinding improves performance, prolongs re-grinding intervals and gives a superior finish to the turned part.

BRIEF SPECIFICATION:

4,800 r.p.m. spindle on opposed Timken bearings.
Lapping speed 5,000 surface f.p.m.
In-built coolant pump and tank.
Fully adjustable table on ball bearing slideways.
Supplied as bench or cabinet model

above left
Table can be inclined either way up to 20°. Tool guide moves 90° with accurately graduated base.

left
Quick, accurate setting.

right
Vertical feed with adjustable micrometer dials.

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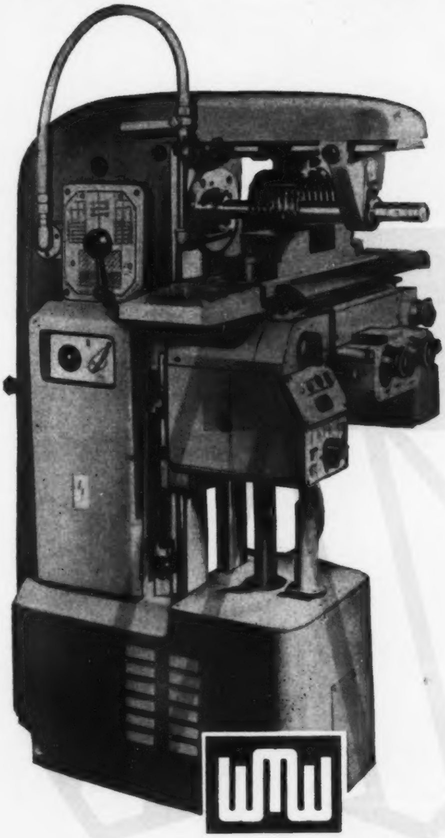
HORIZONTAL KNEE TYPE MILLING MACHINE

MODEL FW 160 x 630



Available styles:

a) Changing of spindle speeds by change pulleys and with pick-off gears for feeds

b) Change speed gear for the milling spindle drive and 18 step gearing for feeds

VERTICAL MILLING ATTACHMENT VA 160

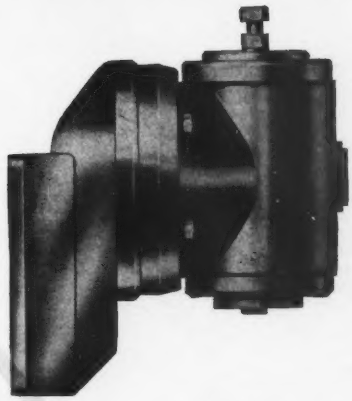


Table size	160 x 630 mm
Machine taper:	
Normal ISA steep taper	40 mm
To option ISA steep taper	30 mm
Range of milling spindle speeds	45—2800 r.p.m.
Range of feeds, normal	5—250 mm/min.
Automatic control of table motions	

CONVENTIONAL MILLING

1 Starting of rapid traverse by press-button. Automatic change over to:
2 Feed to the right
3 Rapid reverse traverse to the left
4 Stop left-hand

INTERMITTENT FEED MILLING

1 Starting of rapid traverse by press-button. Automatic change over to:
2 Feed to the right
3 Rapid traverse to the right
4 Feed to the right
5 Rapid reverse traverse to the left
6 Stop left-hand

RECIPROCAL MILLING

1 Starting of rapid traverse by press-button. Automatic change over to:
2 Feed to the left
3 Rapid reverse traverse to the right
4 Feed to the right
5 Rapid reverse traverse to the left
6 Stop at will by press-button

Vice versa control is provided.

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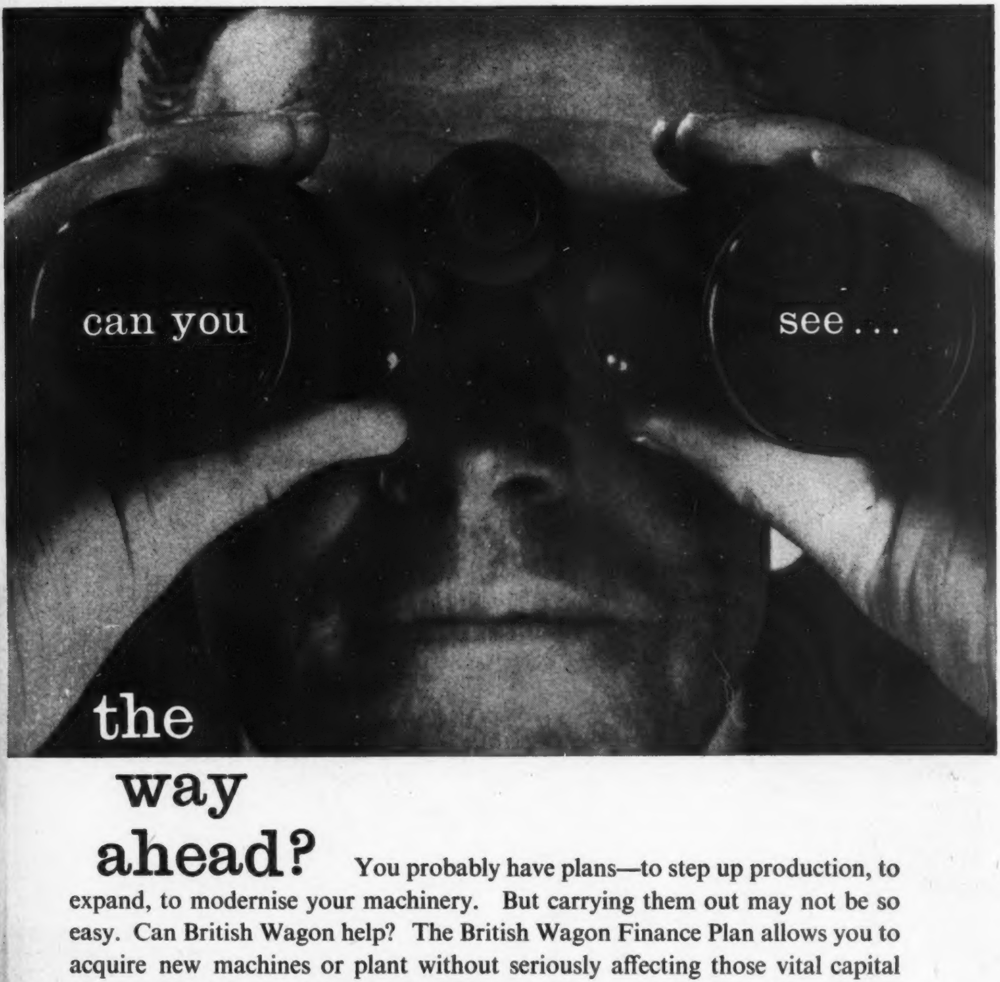

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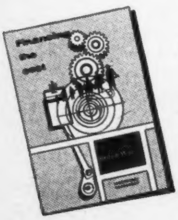

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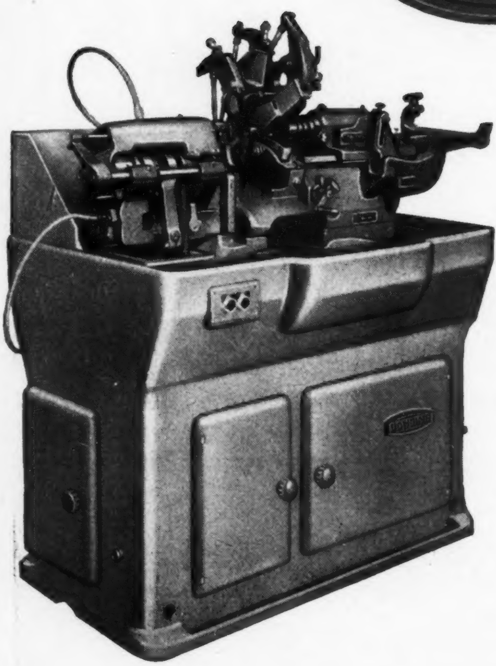

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SLIDING HEAD AUTOMATIC

Work is supported close to the radial tools ensuring maximum accuracy on long slender parts. Second operations eliminated, both ends being completed at the one operation. Radial tools provided with micrometer setting. Sturdy built-in 3-spindle drilling and tapping slide gives maximum threading capacity. Camshaft readily accessible for setting. Wide range of camshaft speeds provided and accelerator reduces idle time.

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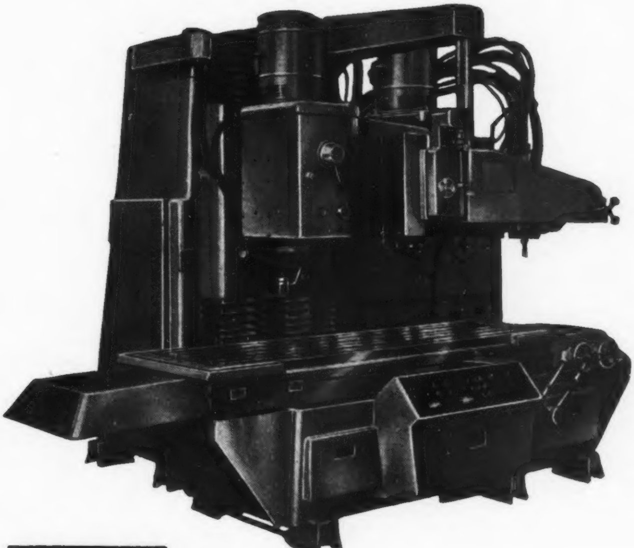

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AUTOMATIC HYDROCOPYING DIE SINKER MODEL KAB 250

Fully automatic — roughing and finishing — this exceedingly robust bed-type machine copies 3-dimensional dies, without supervision, from wooden or plaster models. Both left- and right-hand halves of the die can be copied at the same time from the same master. 360° profiling can be performed at constant feed, without rotating circular tables, *and* on vertical contours. Servo hand control permits speedy roughing. The machine has two spindles; single- and 4-spindle machines are available also.

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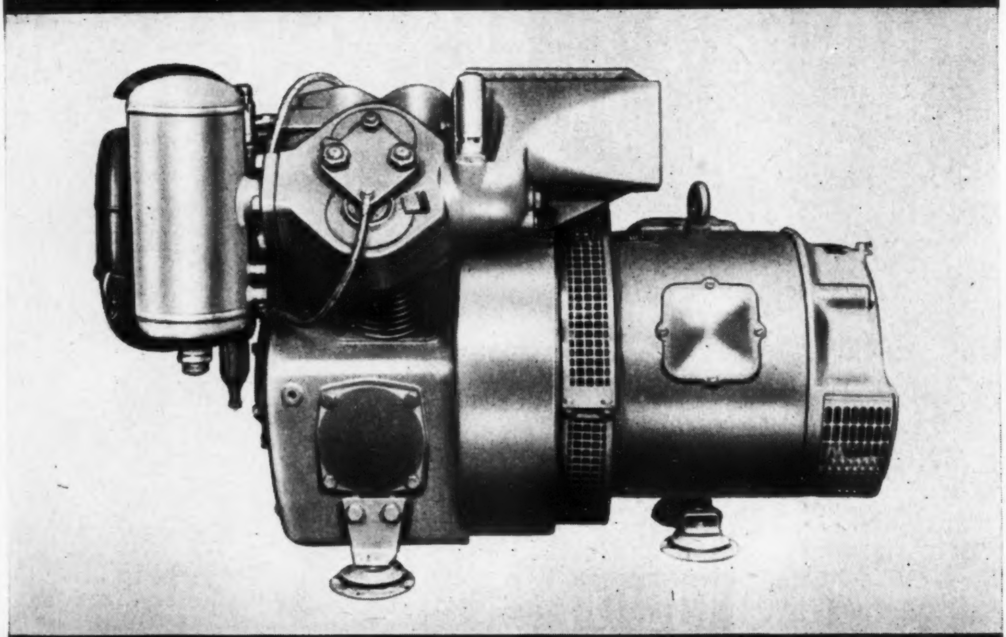

THE ATLAS COPCO COMPRESSOR TT6

Developed from the famous VT portable compressors, the Atlas Copco TT6 is a compact, heavy-duty machine for round-the-clock operation where there is a moderate but continuous demand for compressed air.

The compressor is a single-acting, two-stage machine with air-cooled cylinders and intercooler. It is built for a normal working pressure of 100 p.s.i. and has a free air delivery of 141 c.f.m.

NO FOUNDATIONS NEEDED. The TT6 and its electric drive motor are mounted on 'Metalastik' bonded rubber feet. This eliminates the need for foundations as the compressor can be placed directly onto concrete floors. The TT6 can also be moved from place to place as circumstances dictate.

Like the VT portables, the TT6 combines an outstanding power/weight ratio with a basically simple design which ensures reliable service and easy maintenance. The TT6 is a sound investment for medium-sized or small-but-growing companies.

AUTOMATIC CONTROL AVAILABLE. Available as an optional extra, the Atlas Copco Regulator allows the TT6 to be run with standard valve unloading system or as a fully automatic stop-and-start unit.

WRITE FOR THE LEAFLET Atlas Copco leaflet E1207-1 gives full details of the TT6. It is freely available on request from the address shown.

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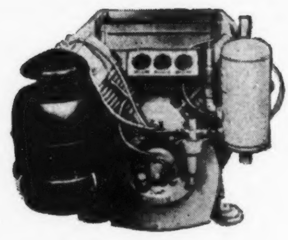

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puts compressed air to work for the world


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- **For all types of circular, flat and spiral broaches up to 72 in. long.**
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Workhead speeds. ...	130, 180, 230 and 320 r.p.m.

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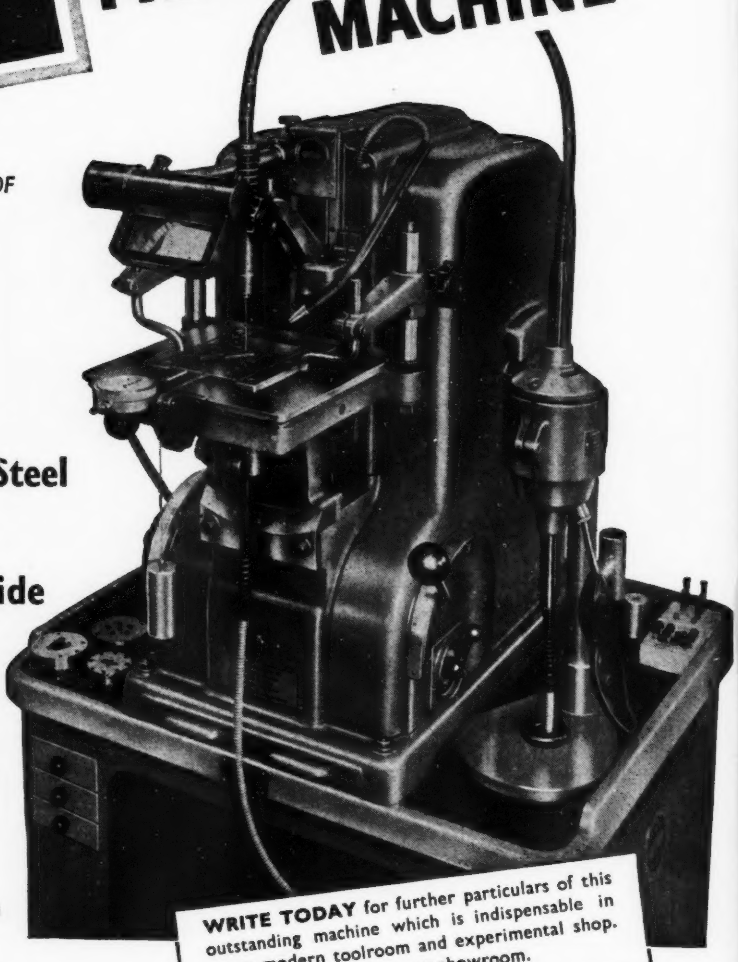
PRECISION FILING & SAWING MACHINE



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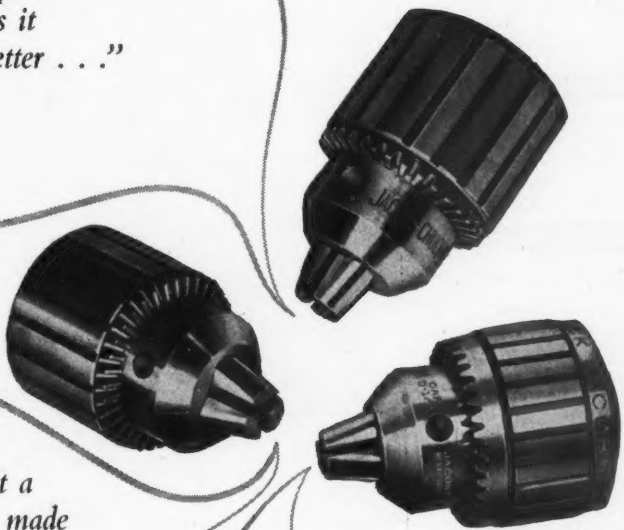

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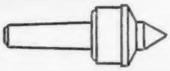

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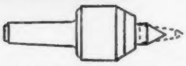

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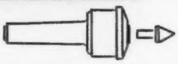

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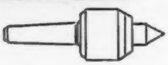

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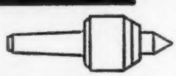

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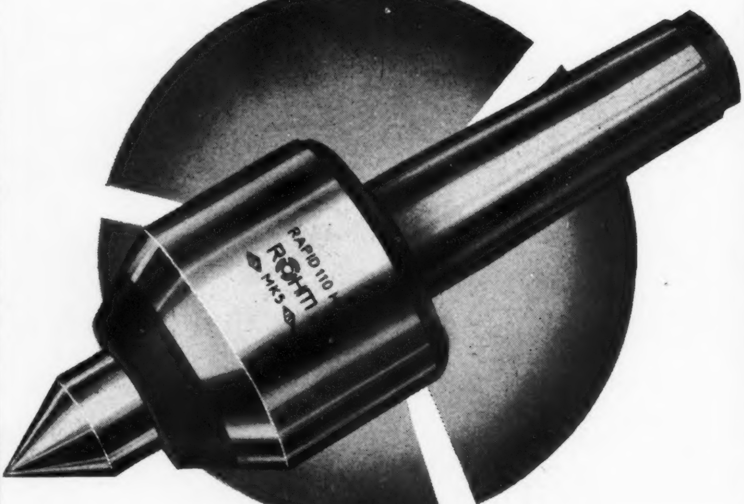

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Whatever your requirements in revolving centres there is a type and size in the ROHM range exactly to meet your needs. Each and every type has been specifically designed to ensure the highest possible performance. Ask for further details.

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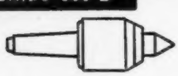

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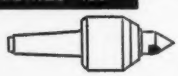

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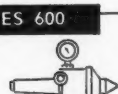

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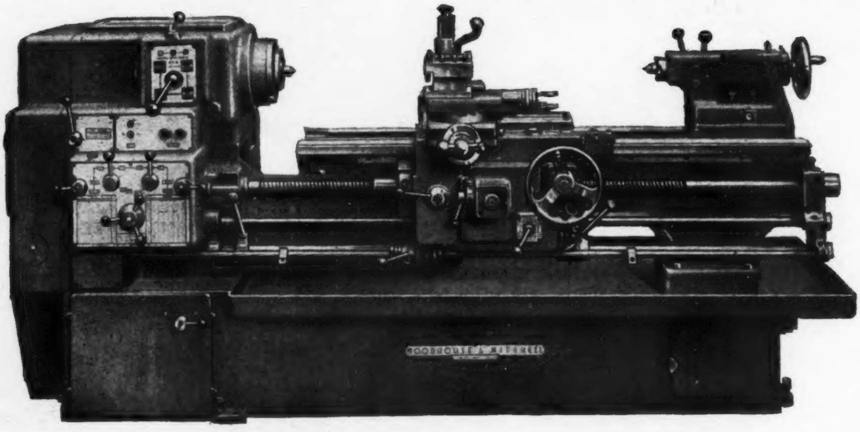
The range of machines produced by Woodhouse & Mitchell includes centre lathes and turret millers. Three of the latest designs are illustrated here : built to modern specifications, they are being used with complete satisfaction by discriminating engineers.

WM WM WM WM



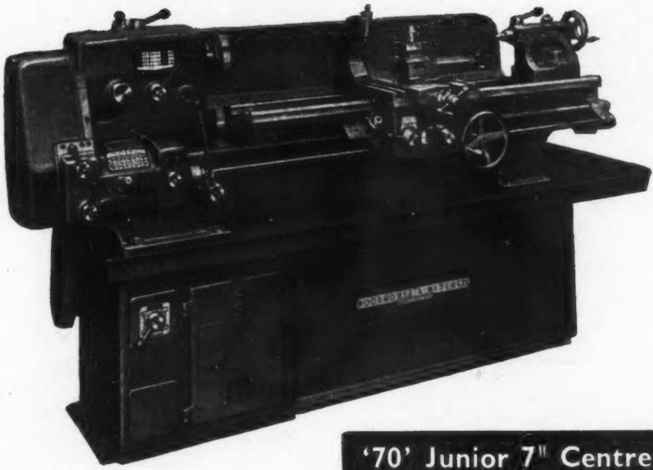
'85' 8½" and 10½" Centre Lathes

8½in. size : 10 h.p. motor, 12 speeds 21-945 r.p.m.

10½in. size : 12 speeds 14-630 r.p.m.

alternative, 21-945 r.p.m.

WOODHOUSE & MITCHELL



'70' Junior 7" Centre Lathe

2 h.p. motor; 8 speeds, 30-437 r.p.m. also alternative 44-640 r.p.m., and (when fitted 2-speed motor) 30-874 r.p.m. and alternatively 40-1200 r.p.m. Sizes are made to admit 45in., 54in. and 72in. between centres.

wm wm wm wm

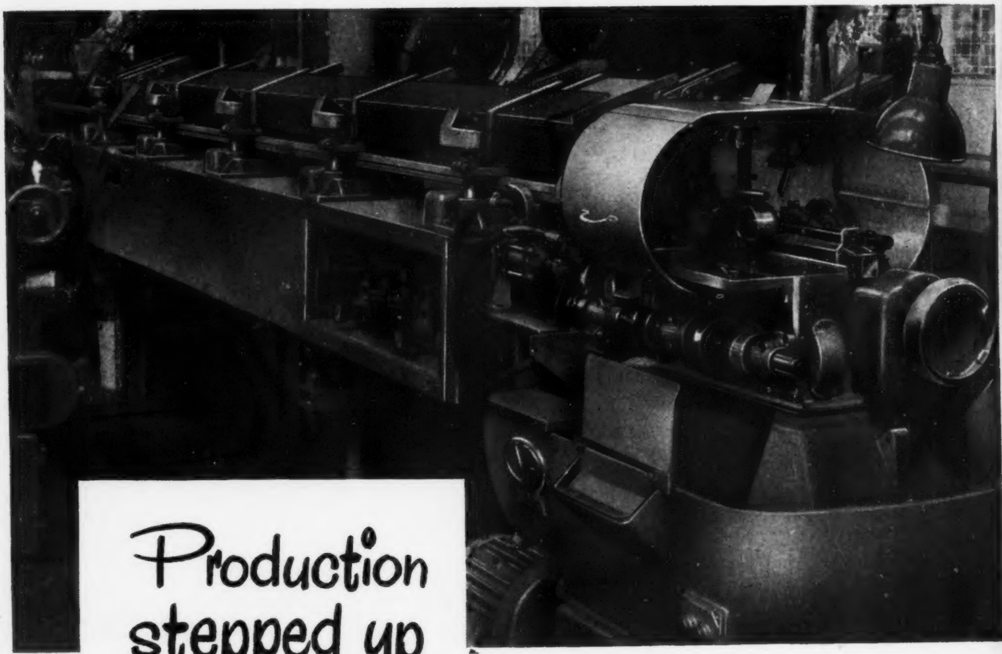
369 Turret Milling Machine

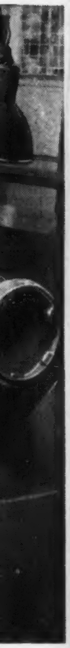
For millling, boring and jig-boring at any angle, key-way and end milling, die-sinking, mould and pattern-making. Table 36in. by 9in., 10 spindle speeds 100-2000 r.p.m. (alternative 200-4000 r.p.m.)

WAKEFIELD ROAD · BRIGHOUSE · YORKS

PHONE: BRIGHOUSE 627 (3 LINES) — GRAMS: 'WOODHOUSE BRIGHOUSE'

WM33





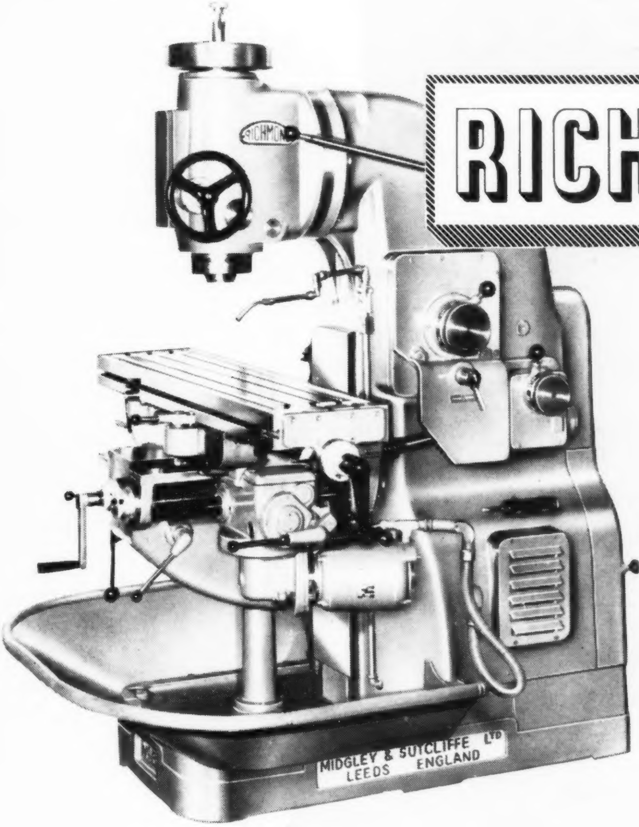
GREATER POWER & GREATER WEIGHT

with the

RICHMOND

Nº 3

VERTICAL MILLING MACHINE



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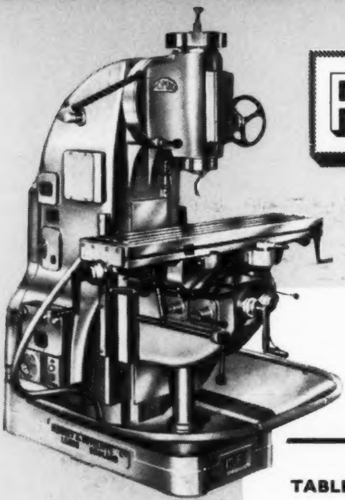

RICHMOND Nº 3

VERTICAL MILLING MACHINE

SPECIFICATION

		ENGLISH	METRIC
TABLE	Overall size and working surface T Slots—number and width .. Centre distance..	48″ × 11″ 3″ × 9/16″ 2½″	1219 mm. × 279 mm. 76 mm. × 14 mm. 63 mm.
FEED RANGE	Longitudinal Power Feed .. Cross Power Feed .. .. .. Vertical Power Feed..	30″ 8″ 16″	762 mm. 203 mm. 406 mm.
SPINDLE HEAD	Spindle: Nickel chrome steel hardened and ground .. .. No. 40 National Standard taper, 3½″ per foot .. Diameter of nose .. .. .. Size of hole through (⅝″ drawbolt) Head Swivels Left of Right .. Spindle adjustment (vertical) .. Spindle nose to table	 YES 3½″ 21/32″ 45° 3″ 16″ (max.) 0″ min.	 YES 89 mm. 17 mm. 45° 76 mm. 406 mm. (max.) 0 mm. min.
SPEEDS	Number .. .. Standard Range in geometrical progression .. Alternative Range .. .. .. Spindle reverse mechanical ..	12 30 to 1,400 r.p.m. 20 to 1,000 r.p.m. YES	12 30 to 1,400 r.p.m. 20 to 1,000 r.p.m. YES
FEEDS	Number .. .. Range—Longitudinal and cross Vertical (one half longitudinal) Alternative Range—Longitudinal and cross .. Alternative Range—Vertical ..	12 .45″ to 12.5″ per min. .22″ to 6.25″/min. .9″ to 25″/min. .45″ to 12.5″/min.	12 11.5 mm. to 317.5 mm. 5.75 mm. to 158.7 mm. 23 mm. to 635 mm. 11.5 mm. to 317.5 mm.
RAPID TRAVERSE	Longitudinal and cross .. .. Vertical	100 per min. 50 per min.	2540 mm. per min. 1270 mm. per min.
DRIVE	Silent multiple V-belt from motor Pulley Speed .. Motor Speed .. Horse Power ..	 600 r.p.m. 1450 r.p.m. 7½	 600 r.p.m. 1450 r.p.m. 7½
SPACE	Floor space occupied	62″ × 97″	1514 mm. × 2464 mm.
SHIPPING SPECIFICATION	Approximate Net Weight .. Approximate Gross .. .. .. Approximate size of case ..	40 cwts. 46 cwts. 72″ × 70″ × 80″	2064 Kgms. 2330 Kgms. 1828 × 1778 × 2032 mm.

We reserve the right to improve or modify the design and construction of these machines and attachments or any part thereof as we may see fit without incurring any obligation on machines or parts previously sold.

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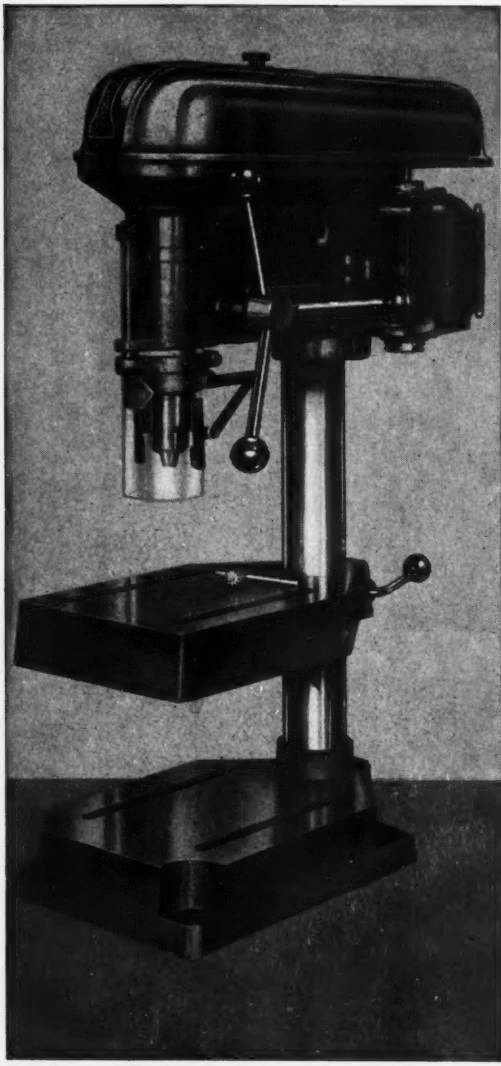

INCOMPARABLE

IN PRICE & QUALITY

- Weight 154 lbs. 70 kgs.
- Five Spindle Speeds
- Throat Depth $7\frac{5}{8}''$: 194 mm
- Column Diameter $2\frac{3}{4}''$: 70 mm
- Quill Diameter 2″ : 50·8 mm
- Robust Spindle and Quill Assembly with splined spindle and driving sleeve
- Large working surface to table and base
- Adjustable Depth Stop and Spring-controlled Spindle return

Supplied complete with 0-½in. Chuck, 3 phase motor, rotary on/off starter. Pedestal model £2.15.0 Extra. Single phase electrics £2.10.0 Extra.

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IPSWICH ROAD, TRADING ESTATE, SLOUGH, BUCKS.
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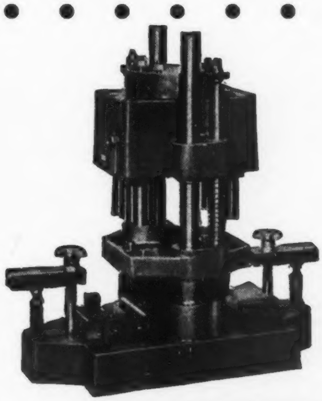
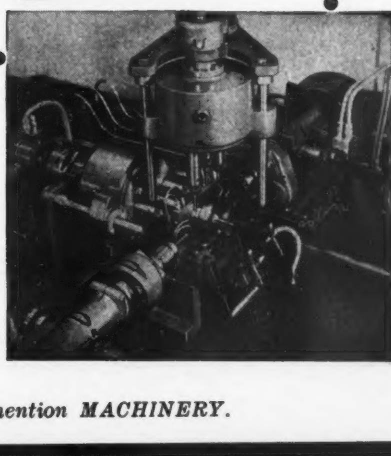
Obtainable from all leading Machine Tool Merchants, or write to us for details of your nearest stockist.

LET'S PUT OUR HEADS TOGETHER ON YOUR DRILLING PROBLEM

We supply precision built multi-spindle drilling and tapping Heads to suit your machine—for light, medium or heavy work and with spindles up to No. 5 M.T. Geared, gearless and adjustable types are available to meet your requirements. Additionally, we can supply complete tooling, fixtures, bushplates etc. for your particular application. We design and build special-purpose machines incorporating multi-spindle Heads to meet your own specific needs.





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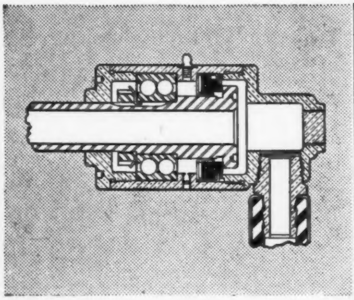
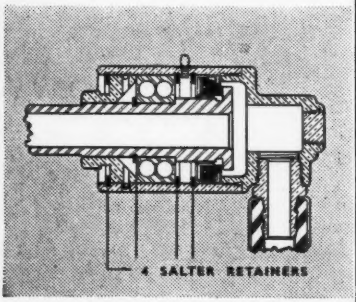
How costs are cut with SALTER RETAINERS

Salter retainers simplify design of air, water, steam union, with great savings



THE OLD WAY Air, water, steam union involved drilling, threading and milling operations. Maintenance was difficult.



THE SALTER WAY Salter retainers permit rapid, simple assembly and maintenance with a reduction in manufacturing costs.

MATERIALS SAVED	
decreased wall thickness of housing	2/9¾
eliminated bearing lock nut and washer	7¾
MACHINE OPERATIONS ELIMINATED	
bore, undercut, and tap cap end of housing	1/4¾
locate cap on arbor and chase threads	1/-
drill spanner wrench holes	4¼
cut thread on rotor for lock nut	3¾
mill slot in thread for tang on lock washer	7½
drill spanner wrench holes in rotor	4¼
ASSEMBLY OPERATIONS ELIMINATED	
install lock washer, tighten lock nut, bend lug	8½
assemble cap into housing	4
TOTAL SAVING WITH SALTER RETAINERS	**8/6½**

*

4 SALTER RETAINERS simplify design, assembly and maintenance with a saving of 8/6½ per unit

NEATER — MORE POSITIVE — PERMANENT RETAINING

SALTER

"TRUARC"

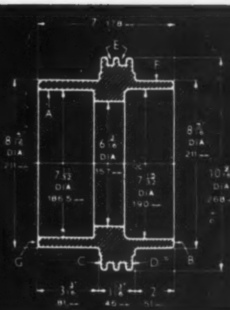
Circlips Fasteners Retainers Fixes

Geo. Salter & Co. Ltd., West Bromwich. Spring Specialists since 1760

H-W.481

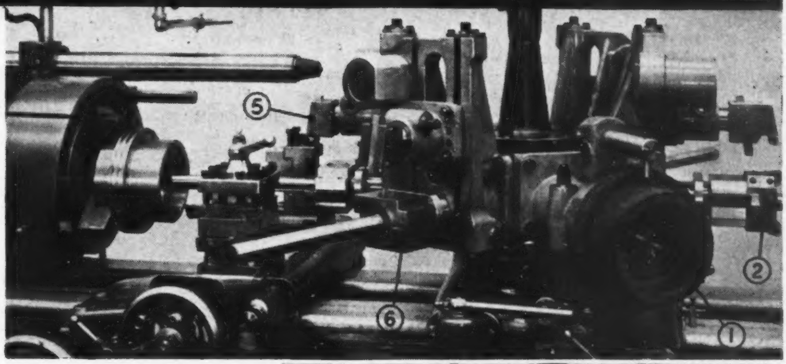
Ward SPECIAL

TOOLING LAYOUT No. 17



PISTON

Machined all over.



PERMALITE MALLEABLE IRON CASTING

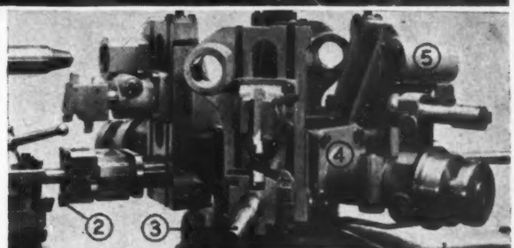
Tungsten Carbide Cutting Tools.

No. 8 TURRET LATHE

Code Word : **Covhylet**

Equipped with 15"—3-Jaw Tudor Chuck.

Total Floor to Floor Time : 22 mins.



DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Max. Cutting Speed		Feed	
	Hex. Turret	Cross-slide		Feet per min.	Metres per min.	Cuts per inch	m/m. per rev.
1st Process							
1. Grip internally in "A" (using loading attachment)	1	—	—	—	—	—	—
2. Rough face "B"	—	S.T.1	102	229	69·7	98	·259
3. Rough knee turn 10$\frac{3}{16}$" & 8$\frac{3}{16}$" dias. and rough bore 7$\frac{11}{32}$" & 6$\frac{3}{16}$" dias.	2	—	84	238	72·5	136	·187
Face "D"	—	S.T.2	84	238	72·5	270	·094
4. Form grooves "E"	—	Rear	102	282	89	270	·094
5. Finish knee turn 10$\frac{3}{16}$" & 8$\frac{3}{16}$" dias. and finish bore 7$\frac{11}{32}$" & 6$\frac{3}{16}$" dias.	3	—	132	365	110·2	136	·187
6. Finish face "B"	—	S.T.2	172	375	114	136	·187
7. Remove component (using attachment)	4	—	—	—	—	—	—
2nd Process							
1. Chuck on "F" (using attachment)	4	—	—	—	—	—	—
2. Rough face "G"	—	S.T.1	102	229	69·7	98	·259
3. Rough knee turn 8$\frac{3}{16}$" dia. and rough bore 7$\frac{11}{32}$" dia.	5	—	102	229	69·7	136	·187
Face "C"	—	S.T.2	102	282	89	270	·094
4. Finish knee turn 8$\frac{3}{16}$" dia. and finish bore 7$\frac{11}{32}$" dia.	6	—	172	375	114	136	·187
Finish face "G"	—	S.T.2	172	375	114	136	·187
5. Remove component (using attachment)	4	—	—	—	—	—	—

'PRELECTOR' Combination Turret Lathes with Preselective speed-changing.

TURRET LATHES with capacities up to 35 in. swing over bed

1½ in. to 2½ in. 'D-S' DOUBLE-SLIDE' Capstan Lathes for heavier accurate work.

Stock Tools, Toolholders, Chucks and Accessories for Capstan and Turret Lathes.

H. W. WARD & CO LTD

SELLY OAK, BIRMINGHAM 29

Phone : Selly Oak 1131

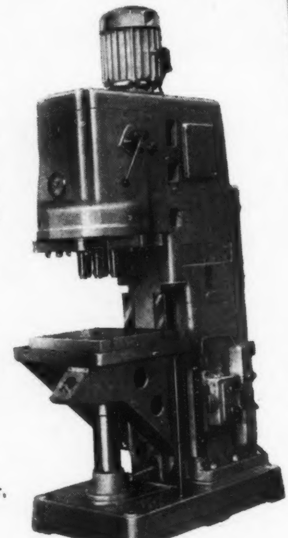
W.690

K&W For the Modern Machine Shop

Multi-spindle Drilling Machines
with adjustable spindle centres

A range of these machines is available and all models have infinitely variable hydraulic feed and automatic cycle of rapid advance, feed, rapid return and stop. Any number of spindles, with either fixed or adjustable centres, can be provided within the machine capacity. A brief specification of each machine is set out below, and we shall be pleased to supply full particulars upon request.

The illustration below shows Model No. 0



RANGE OF MACHINES

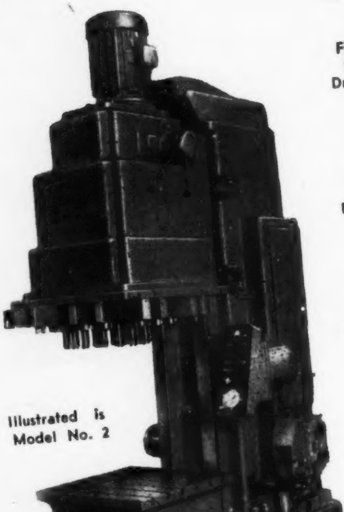
No 0
Fixed head, moving table
Drive motor 5 or 7½ h.p.
Drilling area 10in. diameter, 10in. square or 13½in. x 8½in.

No. 1
Moving head, fixed table
Drive motor 10 h.p.
Drilling area 12in. diameter, 12in. square or 16in. x 10in.

No. 2
Moving head, fixed table
Drive motor 15 h.p.
Drilling area 18in. diameter, 18in. square or 24in. x 15in.

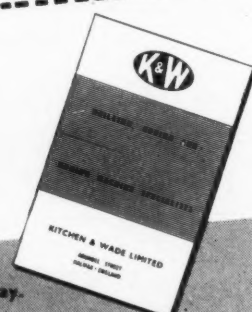
No. 3
Moving head, fixed table
Drive motor 20 h.p.
Drilling area 24in. diameter, 24in. square or 30in. x 18in.

No. 4
Moving head, fixed table
Drive motor 25 to 30 h.p.
Drilling area 30 in. diameter, 30in. square or 36in. x 24in.



Illustrated is Model No. 2

This 60 page catalogue illustrates and describes the range of K. & W. machines for the modern machine shop.



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KITCHEN & WADE LTD. *Member of the Asquith Machine Tool Corporation*

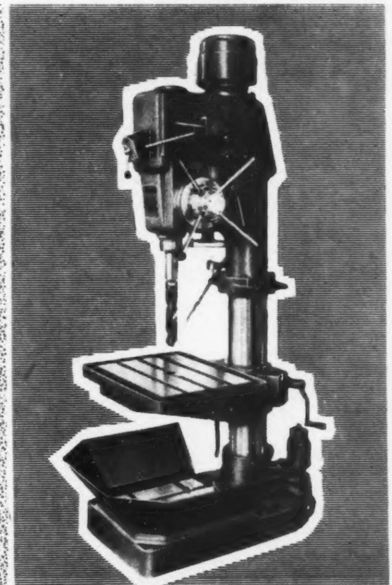
ARUNDEL STREET, HALIFAX, ENGLAND *Telegrams : 'KAW, Halifax'. Telephone : Halifax 67744 (3 lines)*

KW465

ELLIOTT PROGRESS

Drilling Machines

Don't just ' buy a drill '—invest in long life **' Elliott-Progress '**, the world's most popular drilling machine.
Models 4E and 5E offer 3 rates of auto-feed, tap reverse with no-volt release, oil bath and case hardened, nickel chrome gears.

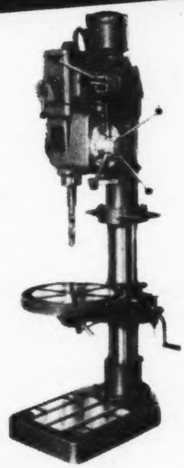


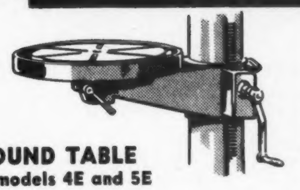
MODEL 5E
PILLAR DRILLING MACHINE 2" *capacity*
9 spindle speeds, 58 to 839 r.p.m.
3 rates of auto-feed.
Tapping reverse, with incorporated no volt release.

ELLIOTT PROGRESS

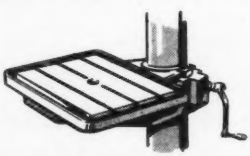
more than a drill— an Investment!

MODEL 4E
PILLAR DRILLING
MACHINE $1\frac{1}{4}$" capacity
9 spindle speeds, 73 to 1,065 r.p.m.
Taper in spindle No. 3 M.T.
Distance between spindle and column $12\frac{1}{8}$"

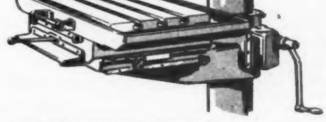




ROUND TABLE
For models 4E and 5E



RECTANGULAR TABLE
For models 4E and 5E



COMPOUND TABLE
Fully Universal Model
For model 5E

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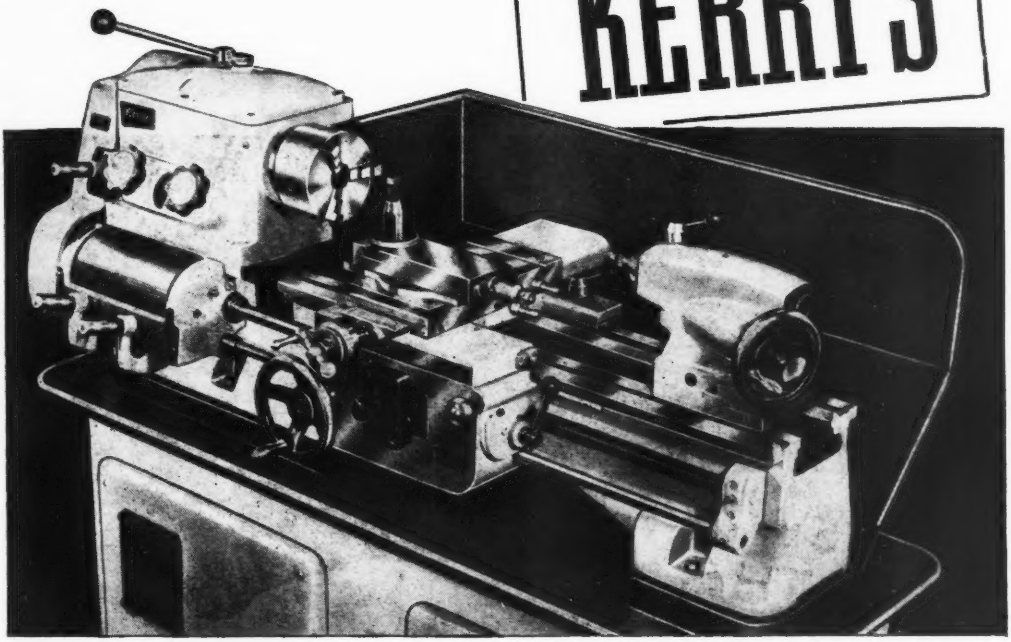
MORE AND MORE ARE TURNING TO KERRY'S



11" SWING LATHES

THOUSANDS in use in Great Britain and throughout the World!

- ★ SLIDING, SURFACING AND SCREWCUTTING LATHE
- ★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.
- ★ TYPE LOO PRECISION TAPERED SPINDLE NOSE
- ★ FEED BOX GIVES 62 PITCHES AND 7 FEEDS FROM ·0004 in.–·024 in.
- ★ CAMLOCK TAILSTOCK
- ★ BEDWAYS AND SLIDES PRECISION GROUND
- ★ HARDENED BEDWAYS OPTIONAL EXTRA

KERRY'S

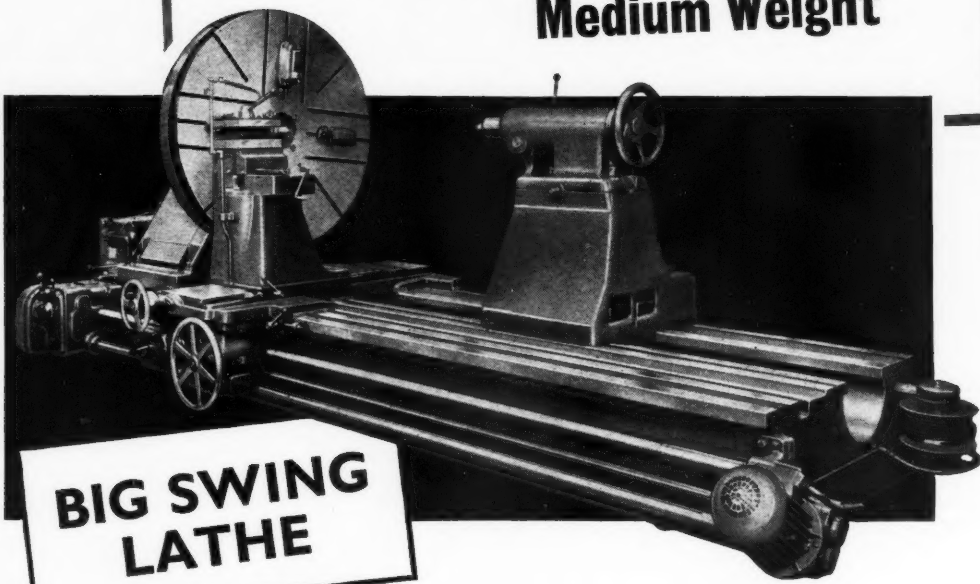
manufactured within the KERRY GROUP by
KERRY'S (Engineering) CO. LTD
GRANGE ROAD, LEYTON, LONDON, E.10

A Kerry COMPANY

Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARyland 6611

E

For Turning LARGE Diameter Drums and Rollers of Medium Weight



BIG SWING LATHE

The O & S Range also includes:

SS & SC lathes from 10½ in. to 24 in. capacity; surfacing and boring lathes up to 96 in. swing; break lathes; railway carriage and wagon wheel lathes; axle journal turning and burnishing lathes; straightening presses.

This lathe will swing up to 6 ft. over the saddle and is specially designed for Turning Drums, Rollers, etc. It is easy to handle, economical in operation and competitively priced. The Big Swing also makes this an ideal machine for general maintenance work.

The O & S Big Swing Lathe incorporates all these features:

- Up to 6 ft. swing over saddle
- Up to 25 ft. between centres
- 12 spindle speeds
- Large hollow spindle
- Spindle bearings PB or Taper Roller
- 32 enclosed change feed and screw-cutting box
- Long lead cutting gear
- Quick power motion to saddle
- Power feed to compound top slide if required
- Power feed to loose headstock if required
- 30 or 35 H.P. motor drive

manufactured within the KERRY GROUP by

OLDFIELD & SCHOFIELD CO. LTD

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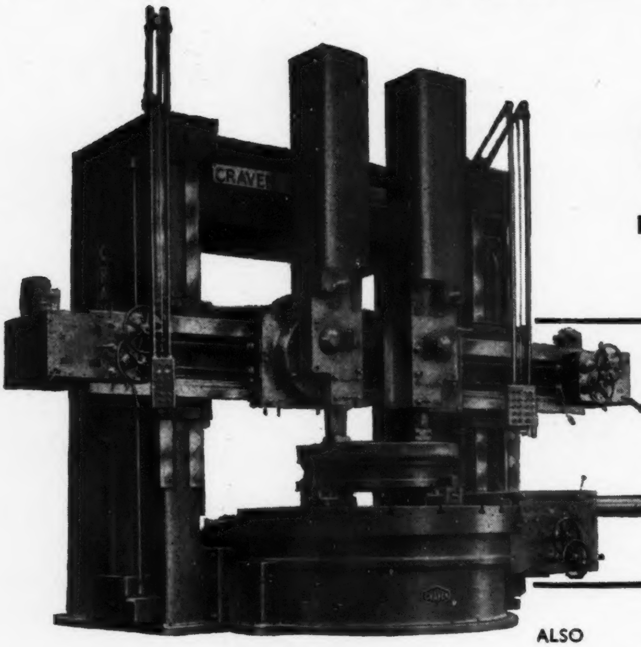


CRAVEN

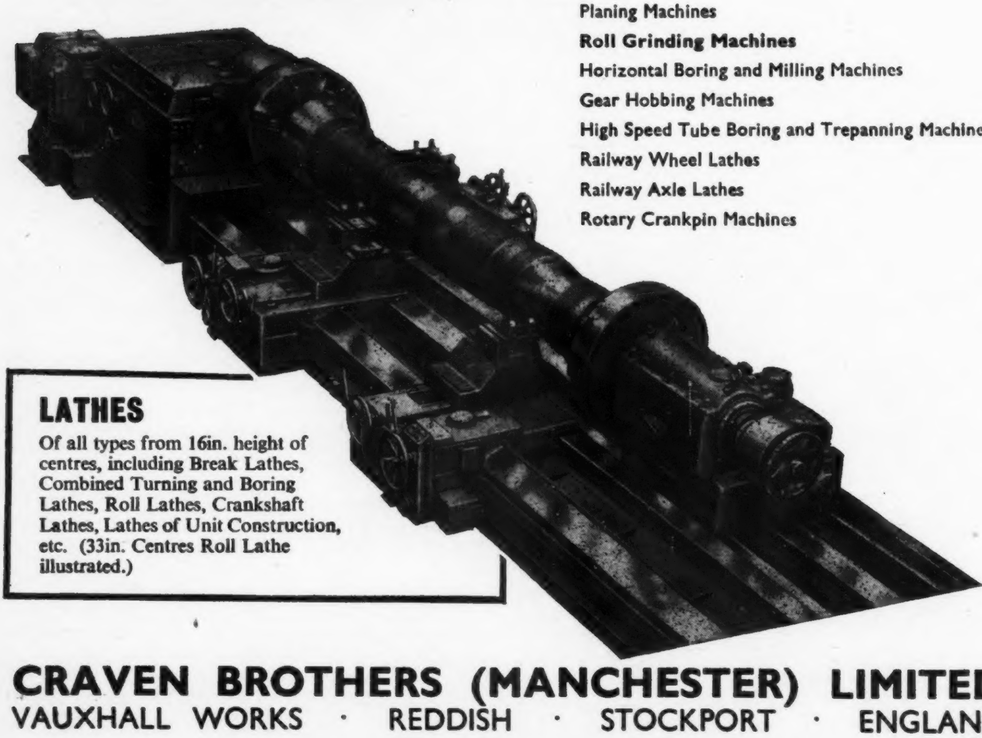
MACHINE TOOLS

VERTICAL BORING & TURNING MILLS

From 8ft. 0in. diameter capacity. Side Head, Profile Copying, Pre-selection of Speeds, Rotary Planing, Constant Cutting Speed Control, etc. (10ft. 0in. Mill illustrated).

ALSO

- Planing Machines
- **Roll Grinding Machines**
- Horizontal Boring and Milling Machines
- Gear Hobbing Machines
- High Speed Tube Boring and Trepanning Machines
- Railway Wheel Lathes
- Railway Axle Lathes
- Rotary Crankpin Machines



LATHES

Of all types from 16in. height of centres, including Break Lathes, Combined Turning and Boring Lathes, Roll Lathes, Crankshaft Lathes, Lathes of Unit Construction, etc. (33in. Centres Roll Lathe illustrated.)

CRAVEN BROTHERS (MANCHESTER) LIMITED

VAUXHALL WORKS · REDDISH · STOCKPORT · ENGLAND

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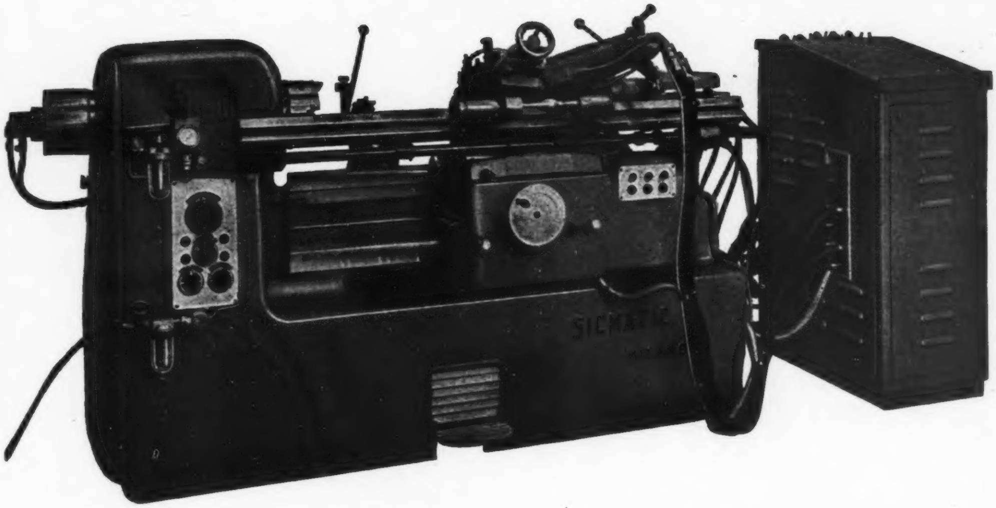
The NEW SICMATIC



Automatic and Semi-Automatic Hydraulic Profiling Lathes

Specification

Bore of spindle	$2\frac{1}{8}$in.
Spindle nose	5in. A.S.A.
Max. swing over bed	$15\frac{1}{4}$in.
Max. swing over saddle	$9\frac{3}{4}$in.
Max. length turned	$27\frac{1}{2}$in.
Hydraulc traverse of copying slide	4in.
Hydraulic feed of tailstock spindle	$4\frac{3}{4}$in.
Number of feed rates to copying slide	48
Max. tool pressure	1,300 lbs.
Approx. net weight	5,000 lbs.

7 POINT FEATURES INCLUDE

1 Capacity.
2 Duplomatic Hydraulic Styems.
3 Hardened Bed Slideways.
4 Auto cycling up to six depths of cut.
5 Hydraulic tailstock for drilling and boring.
6 Uses template or existing component.
7 Eight models to choose from.

Basic price under £2,500.

QUICK DELIVERY

Daily demonstrations at our works

HERBERT WIDDOWSON & SONS LTD

Canal Street Works, Nottingham

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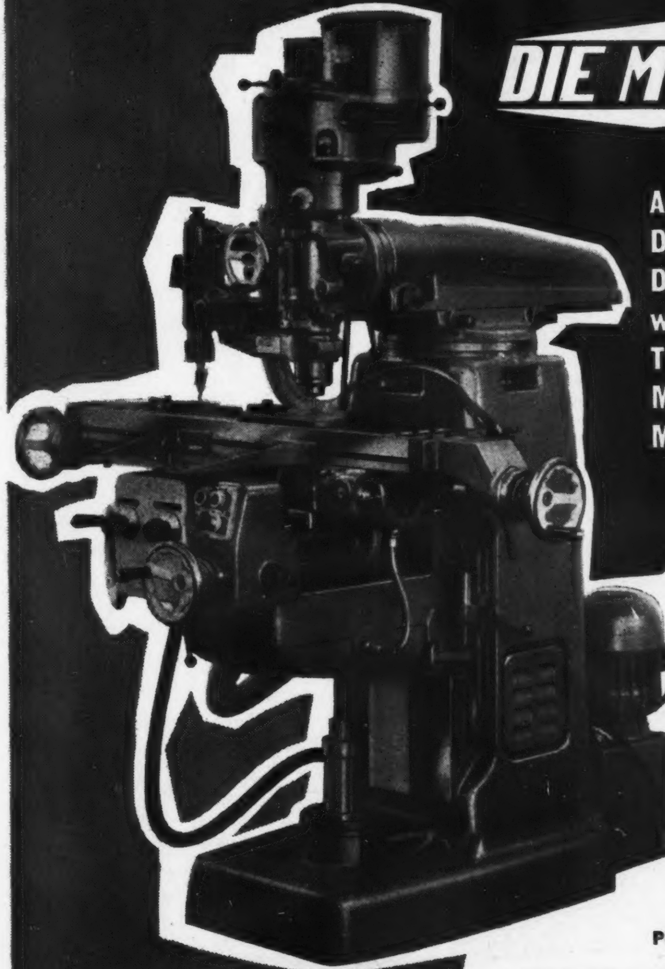


DIE MATIC

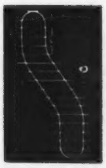
AUTOMATIC HYDRAULIC DUPLICATING DIE-MILLER combined with a **TOOL-ROOM MILLING MACHINE**

SPECIFICATION

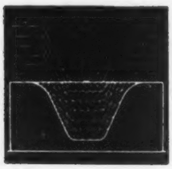
Working surface	43in. × 10in.
Max. dist. spindle to table	$14\frac{1}{8}$in.
Longitudinal table trav. (hydr.+manual)	14in. + 14in.
Vertical (knee) hydr.+manual	4in. + 13in.
Vertical (quill) (mechanical)	5in.
Cross (saddle) (hydr.+manual)	10in. + 10in.
Spindle speeds range r.p.m.	80 to 2715

PRICE £2,125 - 0 - 0 ★

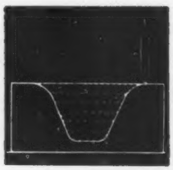
3 Hydra-Way Duplicating *(Finishing)*



1 Automatic Horizontal Scanning of the Model "by Lines"



2 Vertical Depth Duplicating Multicuts by Parallel Layers



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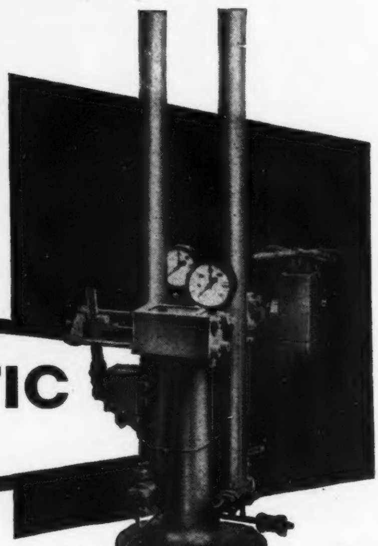

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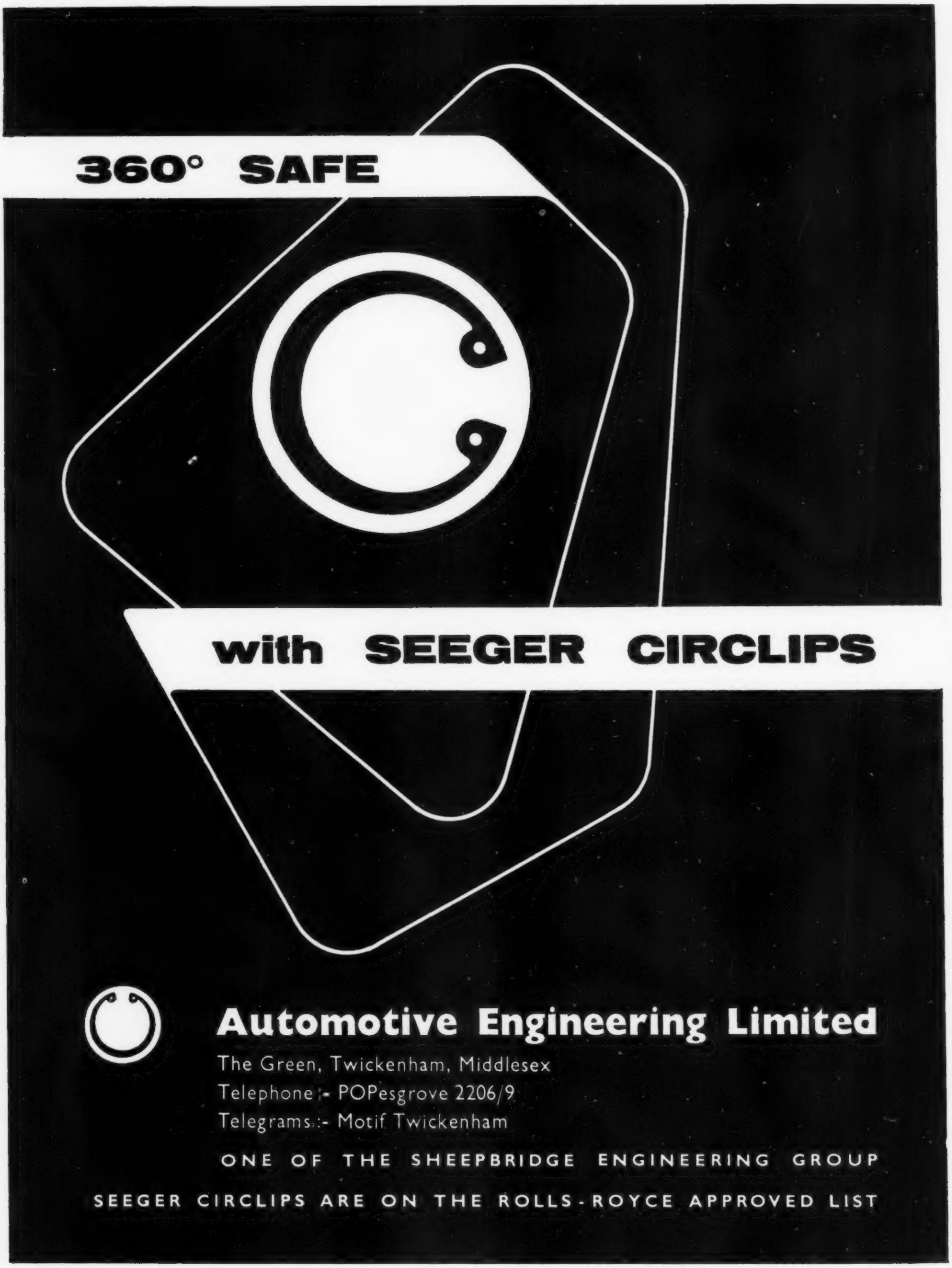
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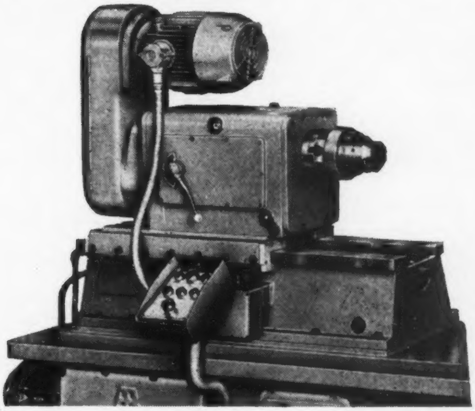

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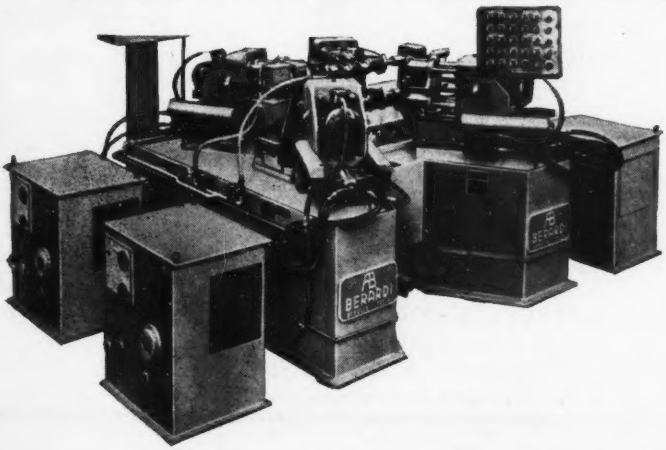

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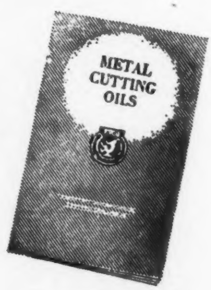

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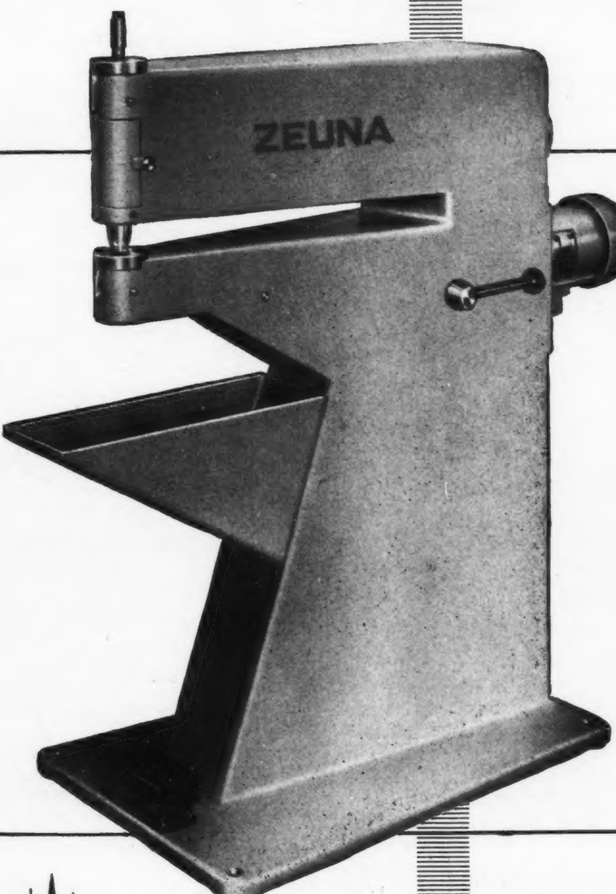

- The combined machine consists of a cantilever upper nibbling arm and a lower counteracting arm, both having a common drive.
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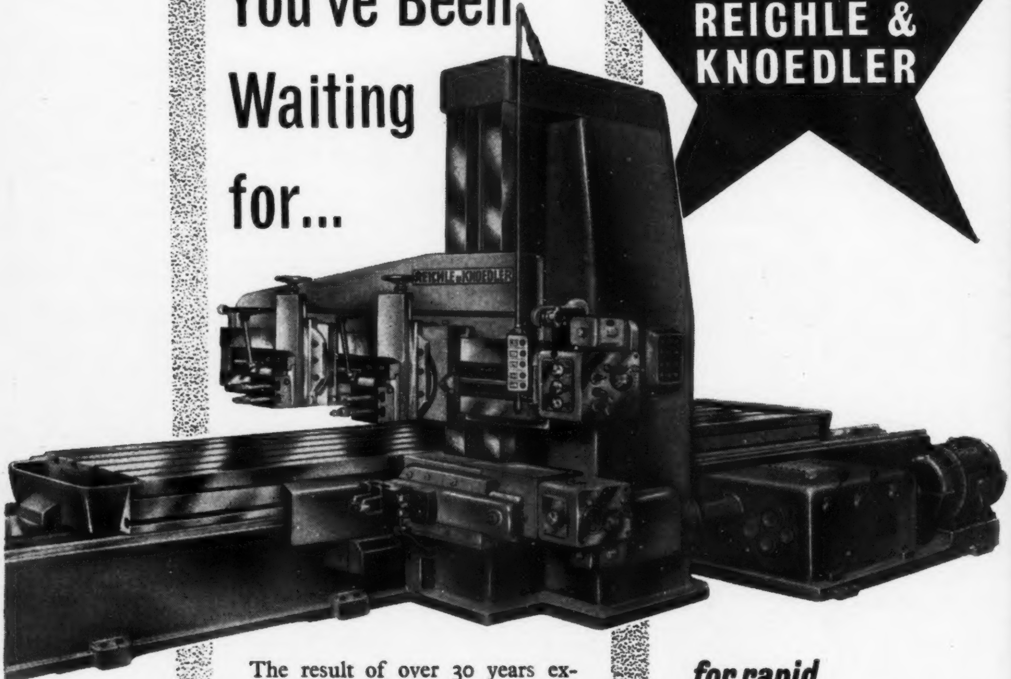

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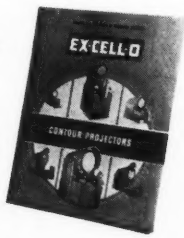

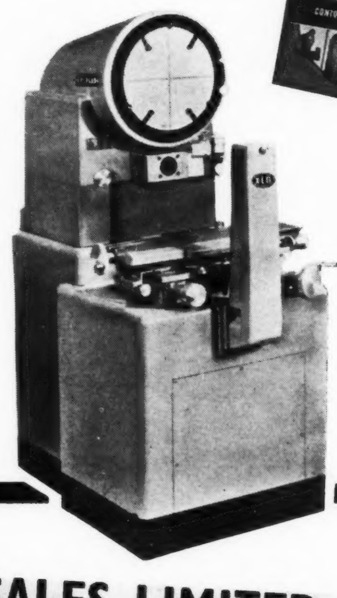

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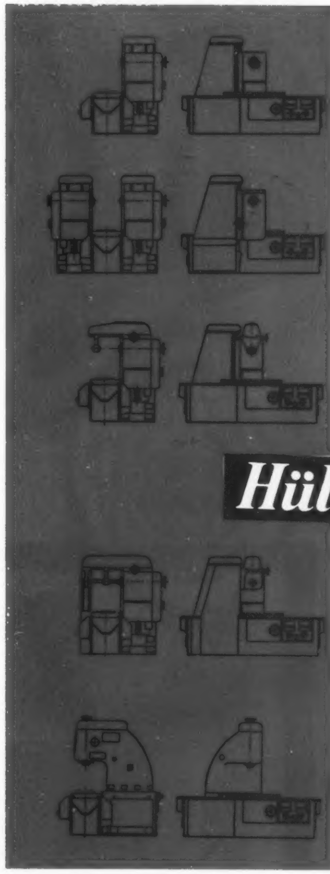

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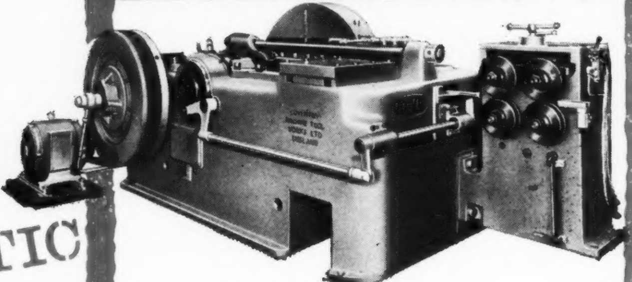
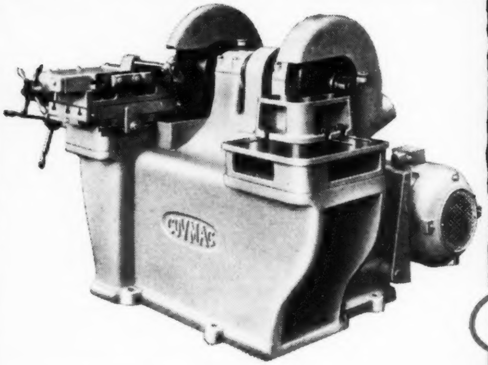


No. 2 machine with guards removed.

The stock is placed between the rolls and is then fed through the dies to the workstop. The die then closes, cutting off the stock to the required length, and delivers it to the heading position. The heading tool then completes the forging, which falls down the chute and is taken away by conveyor.

The Automatic Forger can be supplied in several sizes and for making balls of up to and including 4in. diameter.



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No. 3 machine illustrated.

These machines are made in three sizes. The smallest handles bars up to 2in. diameter. The largest size, as illustrated, takes bars up to 4in. diameter. They are an invaluable asset to any forging or drop stamping plant. We also make nine sizes of Standard Upsetting Machines to take bars from ¾in. to 6in. diameter.

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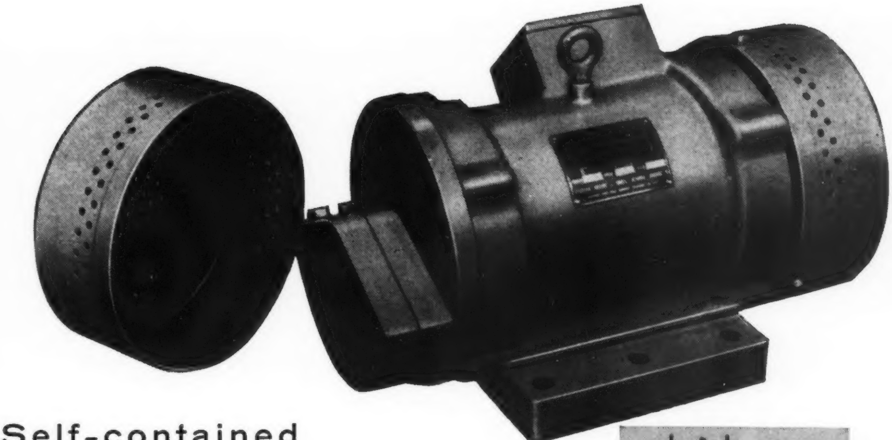

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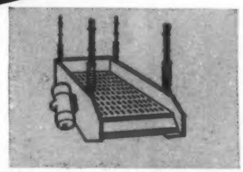
for all

vibratory motions...



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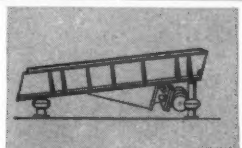
Confectionery Moulds Vibratory Massage Machines



These motors eliminate all parts associated with eccentric shaft arrangements and can be used wherever a vibrating motion is required. Vibration is generated by out-of-balance weights at each end of the motor and single-bolt adjustment gives outputs up to 7,760 lb. centrifugal force at 1,500 r.p.m.

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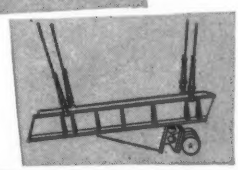

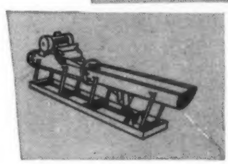

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GEARS FOR

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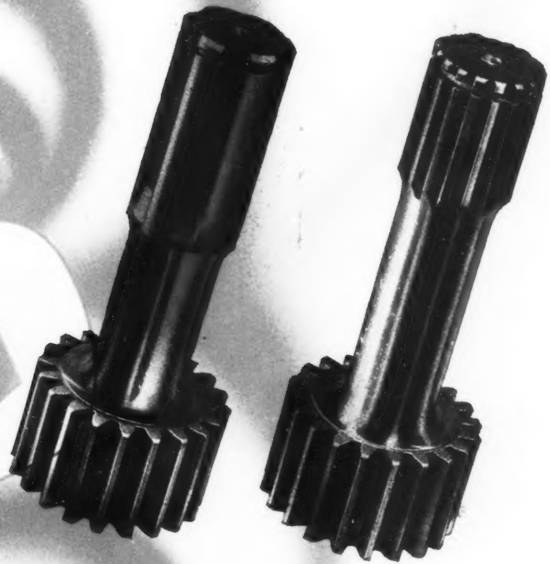

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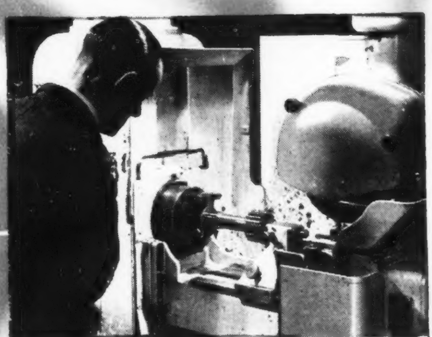

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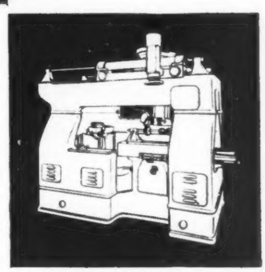

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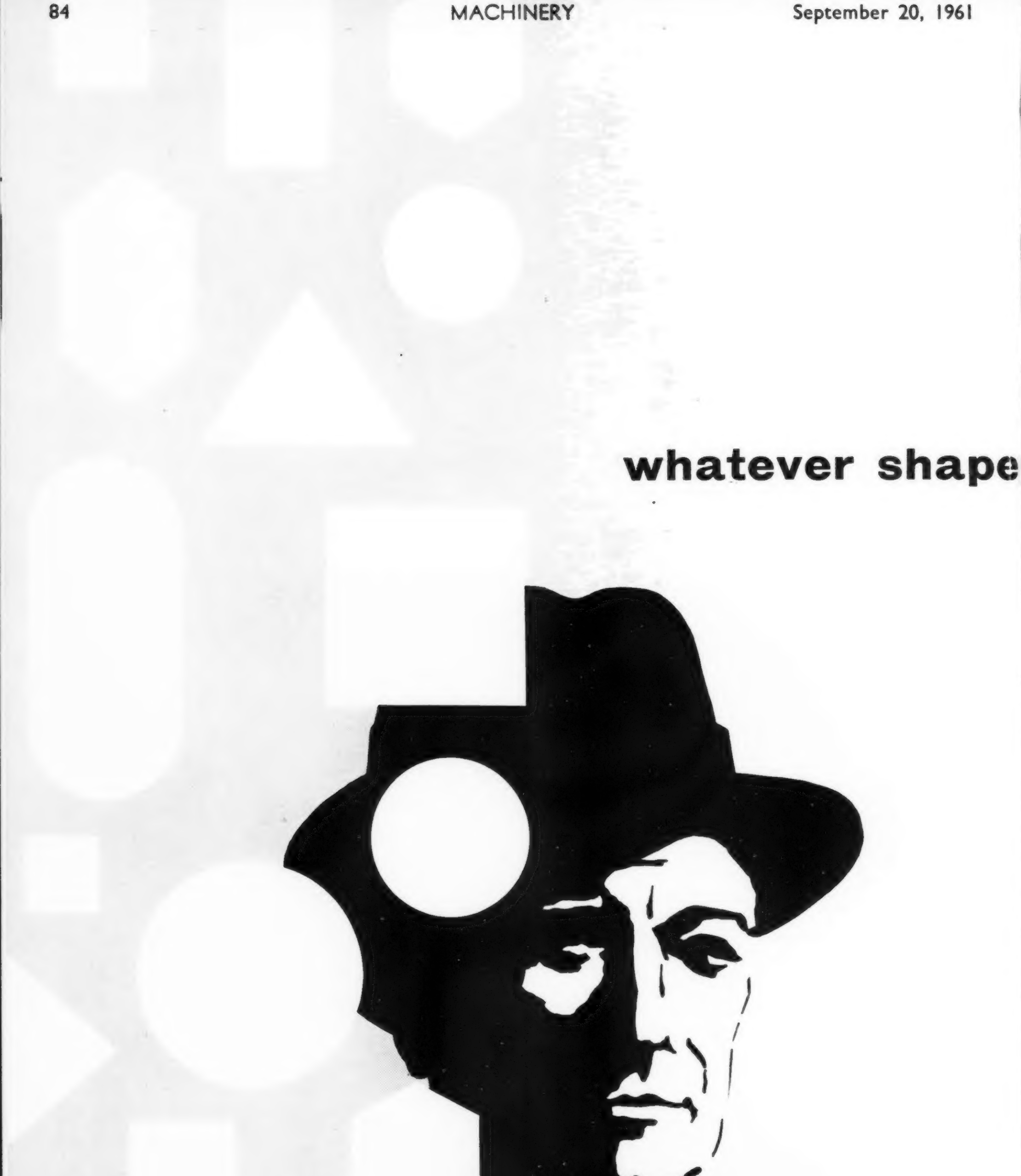
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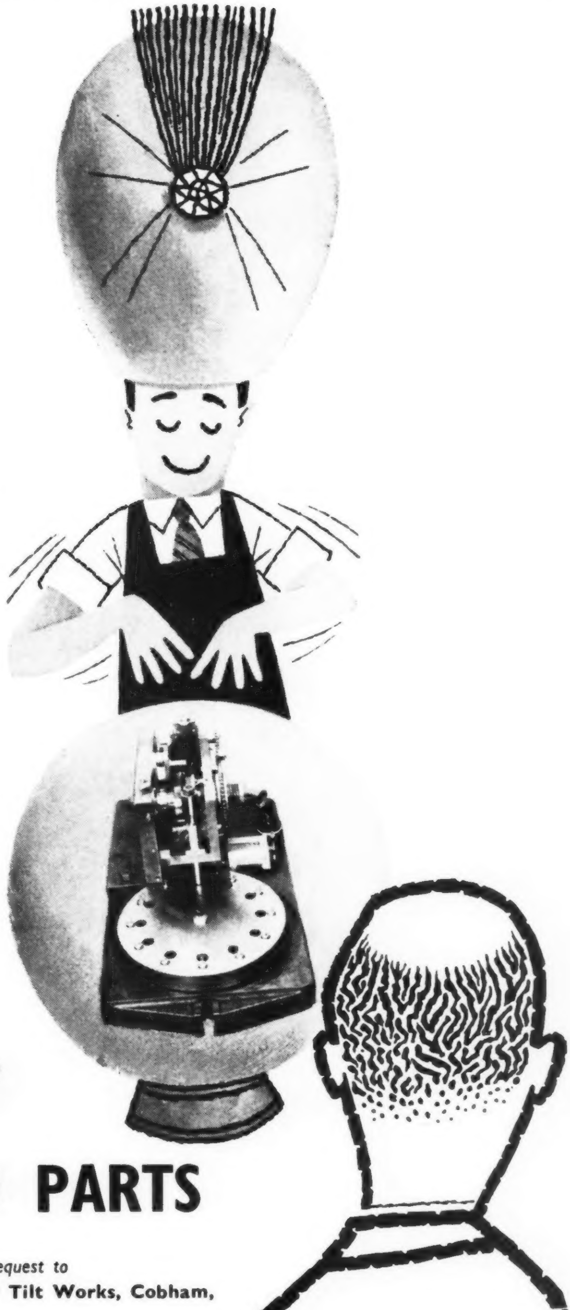

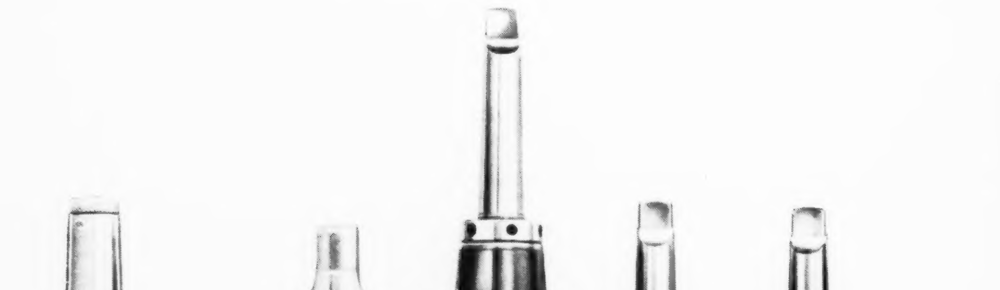

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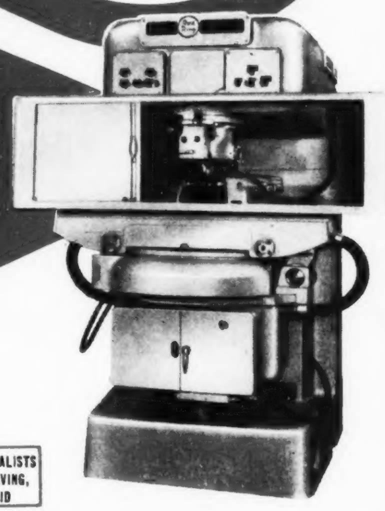

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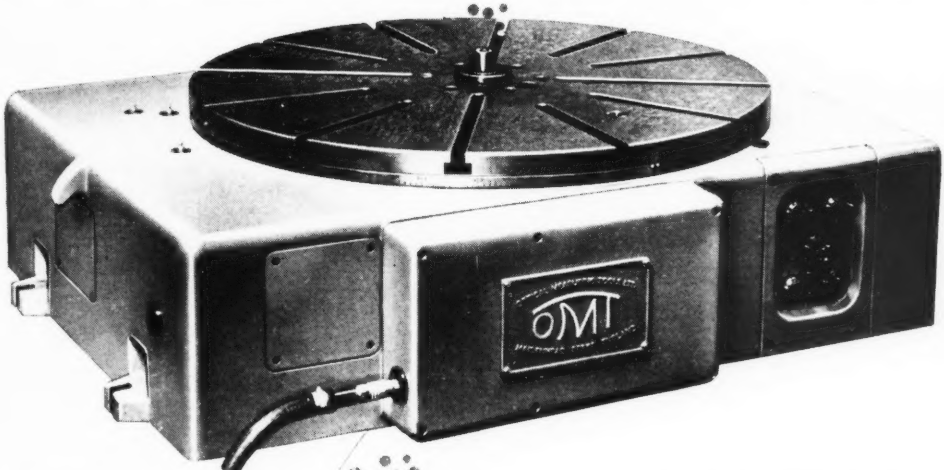

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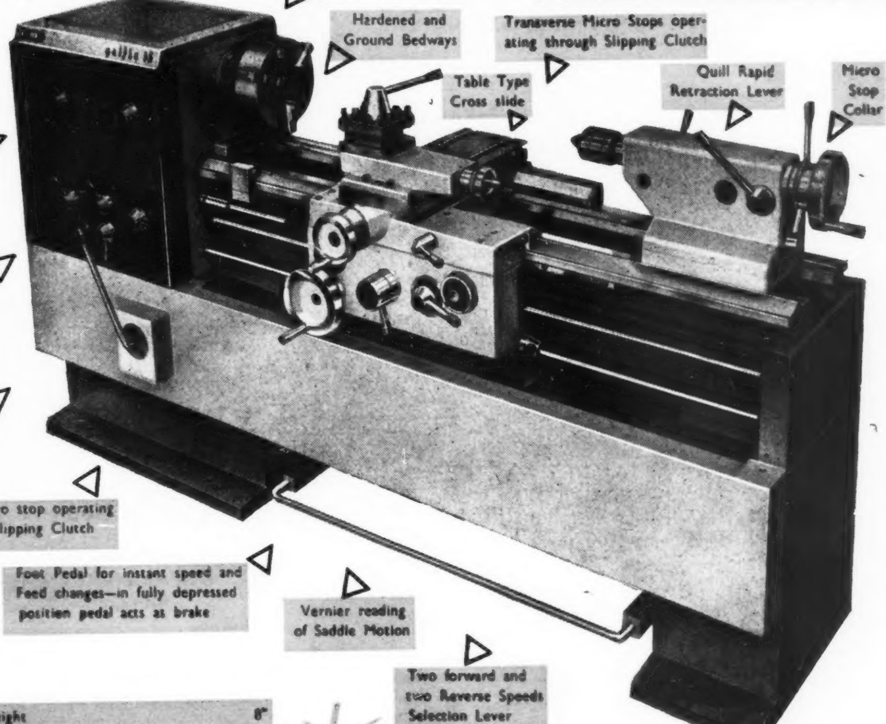

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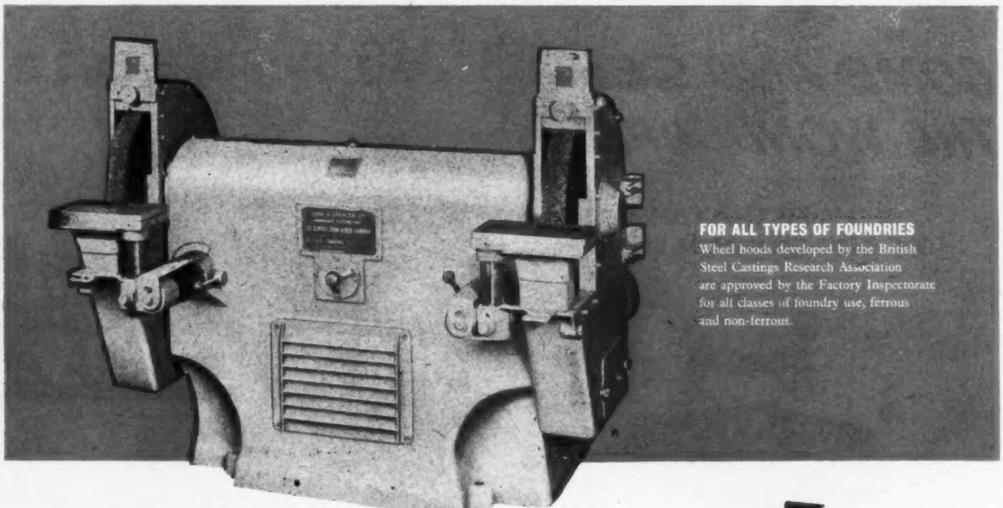

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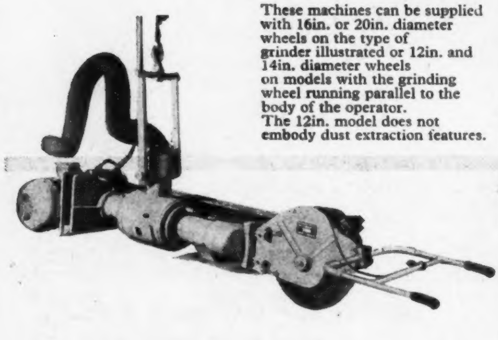

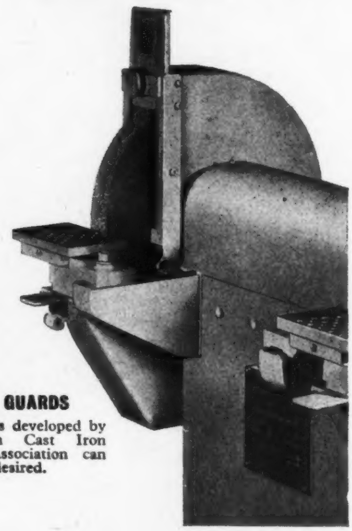

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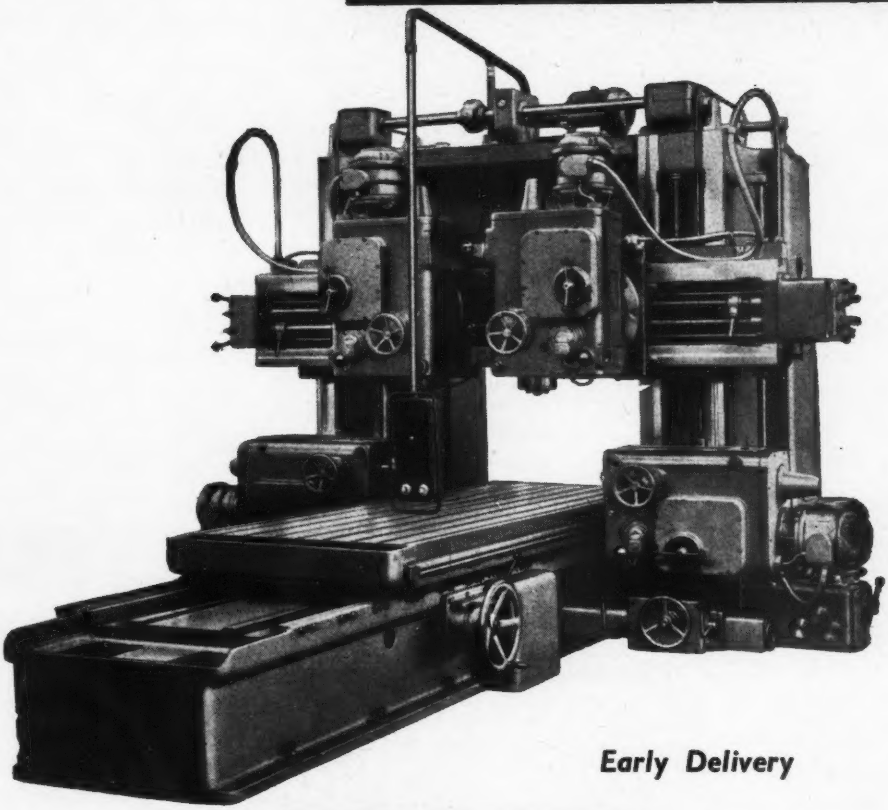

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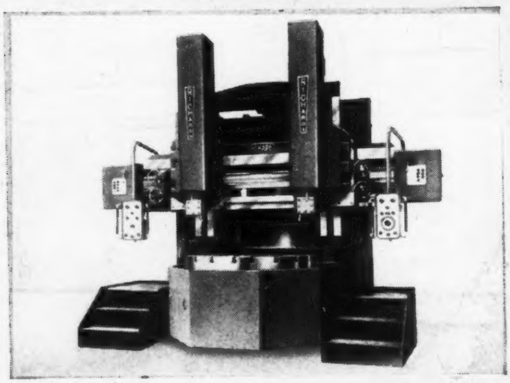

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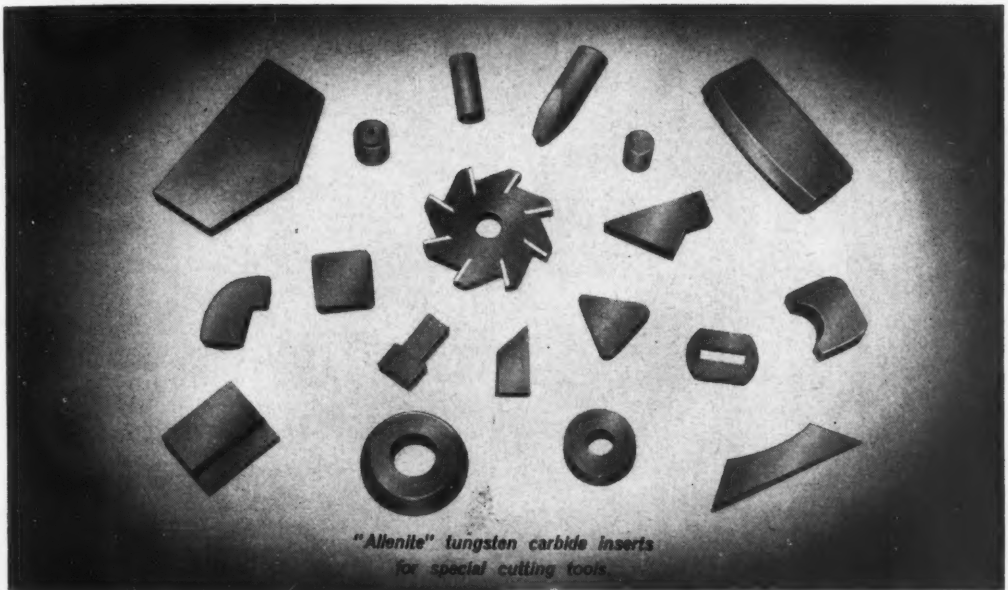

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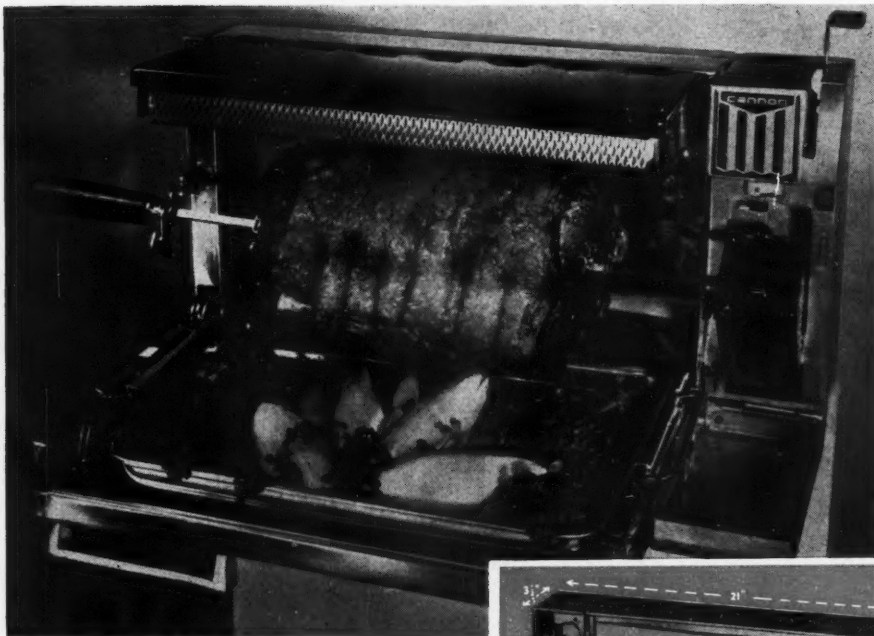

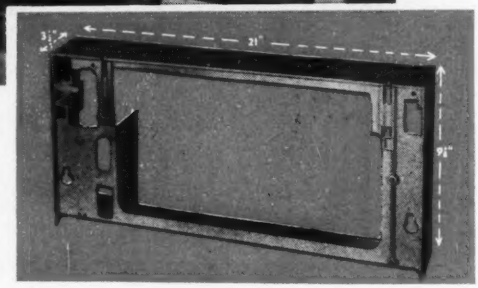

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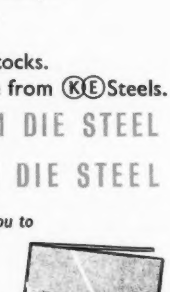

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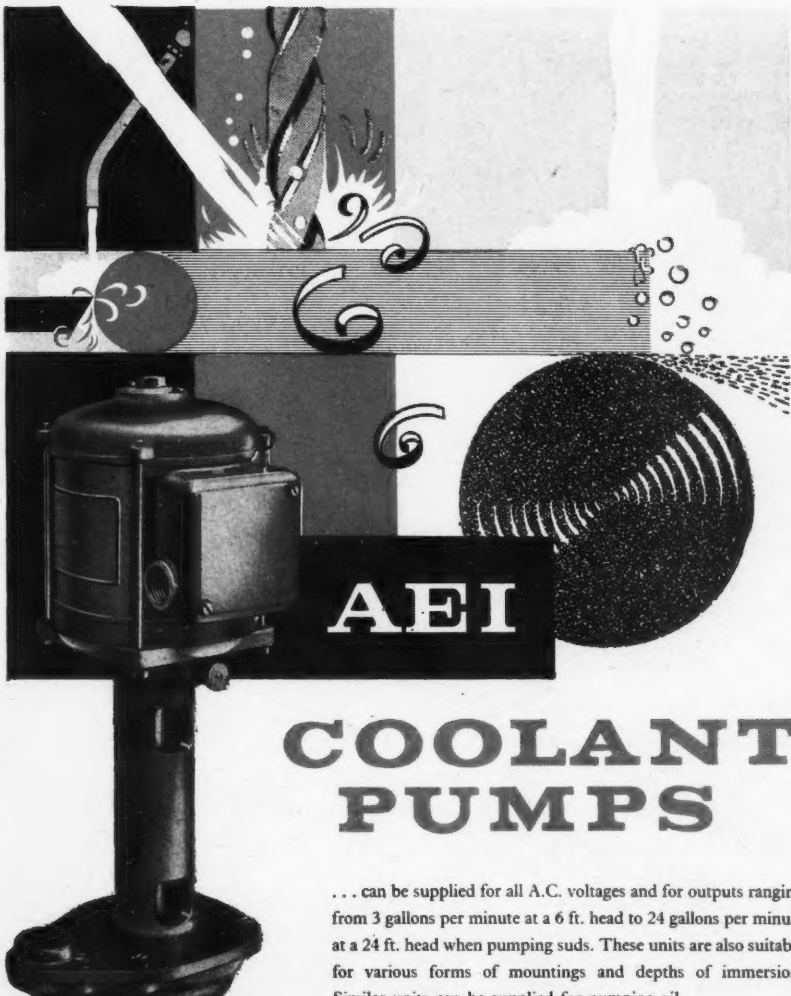

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Abstracts of Principal Articles

VEB Carl Zeiss, Jena .. .. .. P. 652

This article, which is the first of a series concerned with the East German organization of VEB Carl Zeiss, Jena, gives a brief history of the company, which was founded in 1846, and of the Zeiss Foundation. Established by Ernst Abbe, in 1891, the terms of this Foundation transferred the entire company to those who were active in the creation, maintenance, and expansion of the undertaking, and laid down conditions which were far in advance of ideas prevailing at that time. A review of the organization as it exists today is followed by a section on the hours, wages and conditions of work, which have been changed remarkably little by the coming of communism. One of the difficulties which the organization has always faced is associated with the multiplicity of instrument designs produced—now numbering more than 2,000, with several hundred thousand different parts. For this reason, the Mitrofanov method has been introduced, for the purpose of standardizing, as far as possible, the designs of similar parts, and has proved very successful. Where a wide variety of different parts must be produced, the cost of the necessary jigs and fixtures may also be very substantial and a standardized system has been introduced to enable economies to be made in this connection also. (MACHINERY, 99—20/9/61.)

Making Components for Kopp Variable-speed Units .. .. P. 662

In this second article concerned with the practice at the works of Allspeeds, Ltd., examples are given of milling operations on iris plates and end covers. Extensive use is made of " combined operations " on capstan lathes, whereby, with the aid of special attachments, milling, transverse drilling and tapping, also taper-turning, are carried out, in addition to the conventional machining normally performed on such lathes. With this practice, the number of different set-ups is reduced and productivity is increased. Finally, attention is drawn to the methods employed for producing a digital counter housing incorporating a Perspex window. (MACHINERY, 99—20/9/61.)

The Production of Printed Circuits and Industrial Nameplates .. .. P. 670

In this second article, concerned with the methods employed by Millett, Levens (Engravers), Ltd., and their subsidiary company, Printed Circuits, Ltd., fully-automatic plant, of advanced design, for etching and dye anodizing, is described. Both installations, provide for automatic programming, and in the etching plant, three different materials can be processed simultaneously, on a selective basis. Reference is made to the procedure adopted in the " tooling " section, for the various cutting, blanking, piercing and drilling operations on circuit-boards and metal nameplates, that follow processing. The preparation of drilling templates, and piercing and blanking tools, is facilitated by the use of an etched-replica technique, based on printed-circuit methods, which eliminates marking-out. For certain piercing and blanking operations on circuits, it is necessary to heat the work, and for this purpose, use is made of infra-red lamps. Inspection of the finished circuits is facilitated, where possible, by the use of light-boxes, and simple electrical test rigs. (MACHINERY, 99—20/9/61.)

Developments in the Forging of Materials for Service at High Temperatures .. P. 687

Investigations have been carried out by the Wyman-Gordon Co., U.S.A., in connection with the forging of high-temperature metals and alloys. Die wear is greatest with the refractory metals, some of which are now being forged experimentally at temperatures in excess of 2,500 deg. F. Dies used for iron- and nickel-base alloy forgings do not normally exhibit excessive wear. In order to obtain satisfactory forgings, melting of the metal must be carefully controlled, and vacuum melting is widely employed. Close control of temperature is necessary when forging nickel-base superalloys. Graphite lubricants have been the subject of much study, and some recently developed compounds have additives which produce an atmosphere that assists interlaminar absorption of oxygen and thus reduce friction. (MACHINERY, 99—20/9/61.)

Index to Exhibits at the 7th European Machine Tool Exhibition Described on pages 679—685 of this Issue

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

The Advantages of Vibratory Finishing

During recent years there have been important advances as regards the speed, accuracy, and economy with which components of all types can be machined. Regardless of the quality achieved, however, it is frequently necessary to perform supplementary operations which do not come within the scope of normal machining processes, and these operations can add disproportionately to the total costs of production unless they can be carried out in an equally efficient manner. It is often essential, for example, that the sharp edges and burrs resulting from machining should be removed before parts go into service or are subjected to further processing, and at one time such work was commonly performed by hand. Similarly, it may be desired to remove tool marks from surfaces and to obtain smooth, polished, or burnished finishes, to provide greater fatigue resistance or improve appearance, and for such purposes, also, many parts were formerly handled individually on grinding or buffing wheels of various types.

As a result of developments in finishing processes, however, improved surface quality, edge rounding, and burr removal can now be achieved on a wide variety of workpieces at comparatively low cost. Attention may be drawn, for instance, to the progress that has been made in connection with shot blasting, wire brushing, vapour blasting, and electro-polishing. For many purposes, moreover, barrel finishing and certain similar processes have proved particularly effective. With these processes, as is well known, the required action is obtained as a result of random relative motion between the workpieces and the medium in the presence of water and a suitable compound. It might be thought that the effects produced would be too indiscriminate at least to enable precision parts to be treated without damage. In practice, however, it is found that with a suitable combination of conditions from the very wide choice available, remarkably close control can be maintained. It is also possible to provide fixtures to ensure the separation of components that might be damaged by mutual contact.

Hitherto it has been usual to impart the essential relative movement by rotating a barrel in which the charge of work and medium is contained, with the result that repeated sliding occurs as the mass is carried upwards. For some more specialized applications, however, the work is reciprocated in the medium which remains stationary. More recently, good results have been reported from the use of equipment in which the motion is obtained by imparting vibration to the container. With one design, an open, upright container is employed, which can be tilted for discharging the contents, and there is provision for regulating both the amplitude and frequency of vibration in order to control the action on the work and thus enable the desired effects to be achieved.

One advantage claimed for the method is the rapidity with which the treatment is carried out, and this speed of action is said to be due to the repeated accelerations imparted to the workpieces and medium, and changes in direction of relative motion, with the result that a gyratory scrubbing action is exerted simultaneously on the surfaces of all the pieces. It is also stated that the constant vibration produces in the charge a condition of partial weightlessness which is of assistance in enabling delicate and fragile parts to be treated without damage. Another characteristic of the process is that internal or shrouded surfaces, provided that they are accessible to the barrelling chips or other constituents of the charge are treated as effectively as external areas. In one instance it is reported, a test was carried out to determine the feasibility of removing scale from the interiors of metal bulbs by vibratory treatment. These bulbs were 3¼ in. long by ¾ in. diameter, with a neck opening of $\frac{7}{32}$ in. diameter by ½ in. long, and it is stated that a very satisfactory internal finish was obtained after treatment for 25 min.

As in the case of barrel finishing, larger parts can be held in fixtures for treatment by the vibratory method, with the added advantage that the action is accelerated. If the fixture is supported on the stationary frame of the machine, or externally, the normal processing time, it is claimed, is reduced by 50 per cent. If, however, the fixture is attached to the rim of the vibrating container there is a further time saving of 50 per cent because of the effects of separate additive vibrations. This rapid action is of particular value when workpieces of stainless steel, titanium, and other hard metals are to be processed. As examples of results reported, the following may be noted. On forged and machined turbine blades of unusually hard stainless steel, micro-inch readings for surface finish are reduced by 100 with a treatment period

(*Continued on page* 697)

VEB Carl Zeiss, Jena

History, Organization, and Standardization Methods Employed

By R. E. GREEN, Associate Editor

THE NATIONALLY-OWNED ORGANIZATION known as VEB Carl Zeiss still has headquarters in the place of its foundation—the small university town of Jena in Thuringia, East Germany. Carl Zeiss, the founder of the enterprise, was born in 1816 in Weimar, and in 1846 he set up a small workshop in Jena to make and repair instruments for the university. The majority of these instruments were simple and compound microscopes which were then made largely by trial and error methods, and the small firm made considerable—if irregular—progress, and moved to larger premises in 1857.

By 1866 the firm had produced a total of 1,000 microscopes and at about that time Zeiss was joined by Ernst Abbe who was then 26 and had gained his Ph.D., at Goettingen. During the next seven years a further 1,000 microscopes were produced and during this period the scientific principles involved in lens design were established, so that microscopes could be constructed according to mathematical data supplied by the designer, and trial and error avoided. Production and research continued, and by 1876 the number of employees had increased to more than 50. In 1880 the firm acquired an extensive site on the outskirts of the town where a new factory was built. This factory, it may be noted, is now well within the town, the number of inhabitants having risen from about 20,000 in 1900 to 90,000 today.

Experimental work concerned with the making of various types of glass having different properties was carried out by Otto Schott in conjunction with Abbe at about this time, and resulted in the establishment of the Schott glass works in 1884, which supplied the Zeiss company with special types of glass. The Zeiss works then began to produce other optical equipment designed to extend the field of microscopy, and photographic lenses of the anastigmat type were introduced in 1890, under the name Protar. Further development led to the design of the Tessar lens in 1902, and by 1909 the company had established such a commanding position in the camera lens field that several large companies in Germany were forced to collaborate in efforts to compete with the virtual monopoly which had been created.

For nearly 30 years, Zeiss was the sole proprietor, but Abbe was taken into partnership in 1875, and his own son Roderich in 1881. Zeiss died in 1888, and his son retired in the following year, as a result of disagreements with Abbe, who was left in sole charge of the business.

THE CARL ZEISS FOUNDATION

In 1889, Abbe set up the famous Carl Zeiss Foundation, to which his interests in the firm, also his rights in the Schott concern, together with those of Roderich Zeiss, were transferred in 1891. This Foundation provided, among other things, that the establishment should be owned by all those active in its creation, maintenance, and expansion, in concert. A complete scheme of administration was laid down, which embraced such "modern" ideas as profit-sharing, and insurance against old age and illness. Under the provisions of the Foundation, the wages of Zeiss workers could not be lowered after one year of service, only raised, and the discharge of a worker required the payment of specified compensation. This compensation amounted to six months' pay after three years of service, and it was stipulated that after five years of service the worker must receive at least a quarter of the amount which would have been due as a pension.

These provisions were designed to discourage unconsidered engagement of labour and arbitrary dismissals, but they had an adverse effect on the company after the first world war when, on account of discharges it was necessary to pay out some £100,000. The Foundation also laid down that wages were to be made up of three parts, comprising a fixed, non-reducible, portion, on which the amount of the pension was based; a supplementary portion, earned on the basis of piece-work or merit; and a variable portion based on the annual profits. Another provision was that the salaries of staff members, who did not receive the bonus, should be limited to not more than 10 times the average yearly wage of workers above the age of 24 and with at least three years of service.

Between 1896 and 1902, the bonus amounted to between 5 and 10 per cent of the yearly earnings, but trading difficulties in 1903 resulted in a loss. Workers had come to depend on the bonus, however, so that it was necessary to make advances to those who were in difficulties. At the same time, a co-operative credit supply association was started. In later years, the remaining part of the Schott works was handed over to the Foundation, and the administration of the organization has since remained largely unchanged.

In addition, the Carl Zeiss Foundation of Jena has contributed considerable sums for social and cultural purposes, and pays old age and disability pensions to ex-employees of the Zeiss organization which amounted in 1960, for instance, to 3 million marks (about £275,000).

At the beginning of this century, the range of products was extended to cover opto-physical measuring instruments, telescopes, field glasses, periscopes, and range-finders for military purposes, and in 1908 a range of surveying instruments, including theodolites and levels, was put into production. Point focus spectacle lenses were also introduced at this time, followed, in 1911, by various high-quality motor car spot and head lamps, powered at first by acetylene and later by electricity. In 1913, the need for more land was so great that the house occupied by Abbe and his family had to be pulled down and replaced by factory buildings, the price of adjacent land having risen considerably by this time.

The first world war resulted in an increase in the production of military equipment and a slowing down of development work. After the war, surplus capacity was devoted to the production of a range of precision measuring equipment including micrometers, comparators, and other gauges. In 1920 a toolmaker's microscope was introduced, and was followed by the Optimeter comparator, capable of measuring to 0·001 mm. (0·00004 in.); internal and external measuring machines; screw and gear checking equipment; a thread measuring unit; and an interference comparator for the absolute length measurement of gauge blocks. This latter instrument was based on research at the Institute of Weights and Measures, and was marketed by the independent firm of Schuchardt & Schütte, Berlin.

During the years between the wars, there was a gradual recovery, although great difficulties were experienced during the main period of depression, when the number of employees was reduced to 3,200. By 1939, the number had risen again to 12,000, and the works were almost fully engaged in the production of military equipment, although an extensive research programme was in operation. At the end of the war, the area was occupied by American troops for a period of about three months, and during that time some 200 scientists and technicians left Jena and went to Oberkochen, in Western Germany, where the Carl Zeiss Foundation established a factory for them under the name Opton.

When the Americans left, the Russians occupied the area, and manufacturing operations were allowed to continue for about 16 months, before the major part of the equipment was dismantled and sent to Russia as reparations. These dismantling operations occupied some 6 months, and were completed towards the end of March, 1947. The organization was then left largely to itself to obtain other machines from factories elsewhere in the German Democratic Republic, to buy new machines where possible, and to build equipment for specialized purposes. By 1949, the number

of employees had risen to about 10,000, and a programme of research, development and manufacturing had been launched, covering such products as microscopes; opto-physical measuring instruments; industrial fine-limit measuring equipment; astronomical apparatus; binoculars and telescopes; instruments for surveying, photogrammetry and ophthalmology; photographic lenses and projectors; and spectacle lenses and frames.

During the following years, this programme was rapidly and continuously extended, and there was an increase in the number employed to about 18,600, and a rise in total production to four times the 1949 figure.

THE ZEISS ORGANIZATION TODAY

At the present time, the Zeiss organization is still largely autonomous, although it is required to co-ordinate its planned programmes of production with those of other factories engaged in similar activities and with the Government planning authorities. Direction of the affairs of the enterprise is undertaken by a board of management which includes directors concerned broadly with technical, commercial, research and personnel matters. Advice relating to prices and economic questions in general is given by a small group which includes the chief accountant. A second group, responsible directly to the board, comprises directors of technology, production, quality control, research and development, planning, personnel, economics, and home and export sales.

The main factory of the organization, which has an estimated floor area of about 2,690,000 sq. ft., is still in the centre of Jena and is seen in the heading illustration. This factory is the largest, and here the majority of the Zeiss workers, numbering some 13,000, are employed. Most of the buildings are of several stories—usually five or six—and there is also a 14-storey office block, which was built in 1935-1936. A new block, of 16 stories, in which research activities will be concentrated, is at present under construction, and will be staffed by some 300 scientists and engineers. The block will provide approximately 215 sq. ft. of floor space per worker, and there will be sufficient space to enable the staff to be increased to 500 eventually.

In addition, there are two other factories in Jena, known as the North and the South Works, the former being employed mainly for warehousing purposes. In the South Works, to which further reference will be made later, the heaviest machining operations are undertaken, and astronomical telescopes and other equipment are built, the number of employees being about 3,200. The Zeiss Foundation specifies that the main works must be located in Jena, but several branch factories have been established in surrounding towns, mainly to take advantage of labour supplies.

These factories include a medium-sized establishment at Saalfeld, about 24 miles from Jena by road, where some 1,500 people are employed, of whom 60 to 65 per cent are women. Like the main works, this factory was completely stripped by the Russians—even the lifts and parquet flooring were removed, and even now it is not in full operation, as flooring and special machines have still to be installed in certain shops. Additional equipment to be provided will include turret punch presses, lathes, and milling machines arranged for programme control. At present, the factory produces photo-electric cells and photomultiplier tubes in a range of types and sizes, some with quartz end covers fused to the glass envelopes, also photographic lenses, medical instruments, secondary electron multipliers, radiation detectors, and image converters.

The Saalfeld factory also builds industrial electronic computers, developed from a relay-operated design. Each computer has 7,500 ring-shaped ferrite cores made from a mixture of zinc and aluminium oxides, with iron powder. These cores are wound with coils designed to produce specific electrical characteristics, and are assembled by hand into boards, each containing several hundreds, of which the computer is made up. The completed unit has a memory drum and plug-in circuit-selection panels, and operates on instructions provided by punched cards.

Other Zeiss factories include the WERRA camera works at Eisfeld, near the border with Western Germany, which will form the subject of a later article. At this factory there are about 500 employees, and an output of some 50,000 cameras per year is maintained. Other products include small compression ignition engines for model ships, aircraft and cars, 35-mm. slide projectors, and sub-assemblies for 35-mm. sound film projectors. In another factory, at Dresden, 400 people are engaged almost entirely in the production of optical components for cameras, which are supplied to various factories in the city, where the East German camera industry is now concentrated.

DIVISIONS OF THE ZEISS ORGANIZATION

The Zeiss organization comprises 17 separate divisions, most of which share the same buildings and often the same facilities such as drawing offices and machine shops. In the main works, additions made over the years, coupled with the restoration

of war damage, has resulted in a labyrinthine layout, with the various shops at different levels connected by corridors, lifts, and stairways. The sharing of facilities means that components must often be transported for long distances between operations, especially those of a specialized nature, and these difficulties, it appears, must inevitably raise production costs and increase the total amount of work in progress at any one time.

Generally speaking, Zeiss products, of which there are rather more than 2,000 at present, are made in small batches, 70 per cent of the items being produced in lots of less than 200. Obvious exceptions include binoculars and cameras, for which flow methods are employed. In these circumstances, production methods are necessarily largely conventional, and special machines are only used for operations which cannot be satisfactorily performed on standard types. Efforts are being made, however, to rationalize the range of products and to standardize components, to enable a single design of theodolite housing, for instance, to be used for several different types of instrument. Further reference to this subject will be made later.

Among the major divisions of the organization may be noted those concerned with microscopes and opto-physical measuring instruments, including nucleonic measuring equipment; instruments for surveying and industrial precision measurement; photographic lenses for still, cine, aerial, television and process cameras, and projectors; photogrammetrical and astronomical instruments; electrical and electronic equipment; lens grinding and optical products; spectacle lenses of all kinds, including plain, bi-focal, contact, and sun-protection types; special assemblies and components such as oscillators, photo-electric cells and crystals; design and development of special machine tools for the various divisions; the making of precision parts for telescopes; light alloy castings and pressure die castings; and wood and leather cases of all kinds.

HOURS, WAGES AND CONDITIONS OF WORKS

The Zeiss organization was among the first in Germany to adopt the 8-hour working day when, in 1900, a referendum was taken among the employees as to whether they could produce in eight hours as much as in the nine hours previously worked. Today, all the employees, almost without exception, work from 7.30 a.m. to 4 p.m., with a 30-min. break for lunch, and from 7.30 to 12.30 on Saturday, representing a 45-hour week. Overtime is avoided where possible, but when it is necessary, the payment is 15, 25, 50 and 100 per cent extra on normal days, Sundays, national holidays and religious festivals, respectively.

Average rate of wages paid in the organization is about 440 East marks per calendar month, which is equal to about £40 sterling at the current exchange rate of 11 marks to the £1. It is impossible to generalize about payments however, since there is a system whereby the rate may be changed to enable skill or extra qualifications to be rewarded. With this system, workers are placed in one of eight grades. Those in grades (1) to (4) are unqualified, and the remainder have qualifications of various standards. For the unqualified, educational and vocational training is freely available in a spare-time school provided by the organization, which has a current enrolment of some 6,000 people, who are studying a very wide range of subjects.

The factory also operates an extensive apprentice training school with places for 1,000 boys, who attend classes for two days for every four days spent on practical work during the first two years of their training. Such boys will normally have had 10 to 12 years of school studies, and after completing the full time course they work in the shops for a further year before entering grade (5) of the wage scale. With the acquisition of greater skill, and by continuing to study in the evenings, an ex-apprentice can reach the highest grade which is paid at the rate of 900 marks (£81·8) per month.

Trained engineers start at a salary of 640 to 780 marks (£58·1 to £71·3), according to their qualifications, and can normally rise to 1,550 marks (£141) per month. The number of women workers in the enterprise is about 6,700, or 36 per cent of the total, and almost all of them are employed on production or in the offices, very few being concerned with administration.

By law, every Zeiss worker is entitled to 12 paid working days holiday per year, irrespective of length of service, and after a few years this period may be extended up to a maximum of 18 days. Foremen and administrative staff have slightly longer holidays, and more time may also be given to those engaged on particularly arduous tasks or work involving the use of poisonous substances. In theory, each worker can choose the time for his or her holidays, but the factory naturally prefers that they should be spread over as much of the year as possible. Holiday homes are provided by the organization in the Thuringian forests and on the Baltic coast, at which limited numbers of workers, ranging from 24 to 100 at a time, can be accommodated at extremely low rates, for instance 35 marks (£3·2) for 14 days with full board.

There are also children's holiday camps in which the children of Zeiss workers are accommodated in tents. Sports are encouraged, and facilities,

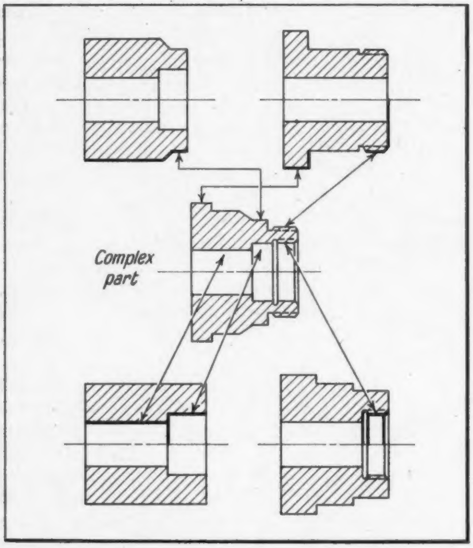


Fig. 1. To arrive at the "complex" part employed in the Mitrofanov rationalization method, drawings of similar parts on transparent paper are superimposed. Here, the complex part is seen at the centre with simpler parts above and below

towards the cost of which each worker contributes 1·3 marks (2s. 3d.) per month, are afforded on a generous scale. Many other amenities are provided by the organization, including a hospital, kindergartens, crèches and day nurseries for children, canteens, hostels, and convalescent homes. In addition, substantial support is given to educational establishments in Jena, and particularly to the university, many members of which have access to Zeiss research facilities.

RATIONALIZATION OF COMPONENTS AND MACHINING SET-UPS

As in most large organizations, departments engaged in the design and production of various items tend to operate independently, and their products incorporate components designed specifically to suit the applications. Even where a single department is concerned with a range of somewhat similar products, the designers often treat each design individually, without considering what existing parts, if any, might be used in the new product. This problem is well known, and a number of different solutions has been put forward from time to time. Most of these solutions involve efforts to re-design components to suit more than one application, in order to reduce the total number of different parts involved, and enable those parts to be produced in larger batches, with consequent savings in costs.

During recent years, a Russian engineer named S. P. Mitrofanov has been very active in advocating, by means of lectures, articles, and books the adoption of a form of rationalization of machining set-ups which he has evolved.

In 1958, VEB Carl Zeiss decided to carry out an investigation into the possibilities of rationalization by the methods laid down by Mitrofanov. One of the aspects covered by this investigation was concerned with the numbers in which different products were made, and it was found that for some 32 per cent of the total, the outputs ranged from 1 to 50 per year. About 68 per cent of all products are required at rates of less than 200 per year, and only 0·6 per cent, at rates between 5,000 and 10,000 per year. Since many Zeiss parts closely resembled each other, it was obvious that there was considerable scope for rationalization, and the Mitrofanov method was adopted towards the end of 1959.

THE MITROFANOV METHOD

With the Mitrofanov method, workpieces are first classified in accordance with the machining or other processes principally involved in their production, for example turning, milling, drilling, grinding, and boring. It is then possible to select groups of parts from the various classifications which present similarities as regards both design and machining. The object is to ensure that the parts in a group can be wholly or partly machined with the same basic set-up, which can be readily modified to meet the individual differences.

To this end, a characteristic part is selected or specially designed so that it incorporates all the features required for all the other parts within the group. In arriving at the form of the characteristic or "complex" part, as it is termed, it is found convenient to prepare drawings of the various parts which will constitute the Mitrofanov group, on transparent paper. These drawings are then superimposed one on another for the purpose of building up the "complex" design. As a simple example, four components from such a group are shown in Fig. 1 with the "complex" part in the centre, and it will be evident that if a lathe set-up is arranged for producing the "complex" part, it can also be employed for the other parts by merely removing certain tools and/or eliminating operation stages. Obviously it is desirable that the components selected to form a

group should have as many dimensions in common as possible, and it may sometimes be feasible to introduce minor modifications in individual designs, with this end in view. It will be understood that the operations list drawn up for the "complex" part suffices for all the components in the group, it being only necessary to delete the operations that are not needed for any particular item.

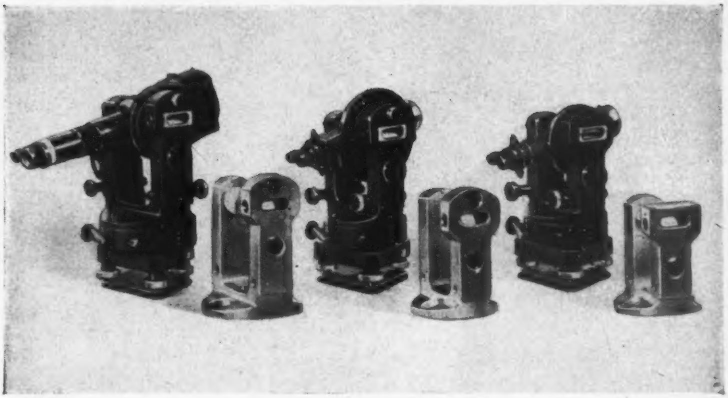


Fig. 3. Similar parts for a range of surveying instrument assemblies have now been combined by means of the Mitrofanov method, so that a single design suffices for a number of different instruments

The idea of producing two or more different parts, or modifications of the same part, by means of a common set-up on a machine or machining line is not, of course, new, and this procedure has, for example, been followed in connection with 4- and 6-cylinder engine blocks of the same bore size. With the Mitrofanov system, however, this practice is extended by systematically selecting parts which lend themselves to such treatment.

Mention may also be made of a somewhat specialized application of the method which is based on the use of standard cams for the production of groups of ring-shaped parts, for instance, on automatics. Here again, the novelty lies not so much in the principle as in the extent of its application on the basis of systematic component classification. It is stated that it has already been found possible to provide common cams to cover the requirements of groups of 20 and 40 ring-shaped parts, and that another cam suffices for 40 parts described as "funnel shaped."

Very striking results can sometimes be achieved when the Mitrofanov system is adopted in conjunction with a programme of orthodox simplification. Thus, it is reported that as a result of careful classification it was found possible to reduce a total number of knurled-edged knobs, estimated at between 60,000 and 80,000, to the 14 shown in Fig. 2, which form a Mitrofanov group. It is emphasized, however, that the method enables good results to be obtained rapidly even where it is not practicable to reduce a wide variety of similar forms to a narrow range.

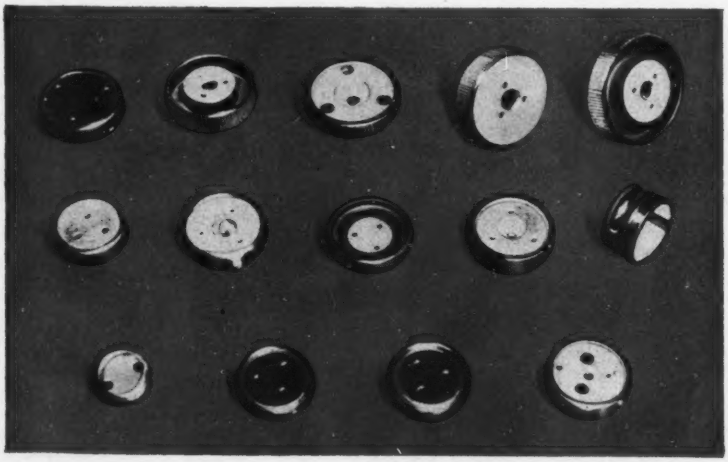


Fig. 2. Some 60,000 to 80,000 different knurled knobs, formerly employed on various Zeiss instruments, have been reduced to a total of 14 designs, as here shown, all of which can be produced with common machine set-ups

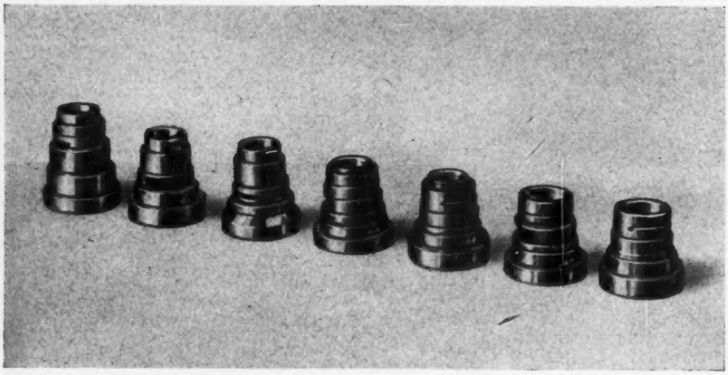


Fig. 4. These lens mountings provide examples of parts of similar shape, which can be produced on a common flow-line basis by the Mitrofanov system

made to persuade designers to take account of the forms of established "complex" parts, so that fresh components can be machined, where possible, with the common set-ups.

Application of the Mitrofanov system to various parts which are made as aluminium pressure die castings or from sheet material, it is pointed out may offer particular advantages, and in some instances, modifications to existing dies may be made to avoid the need for producing completely new tools. It may also be noted that with this system, apart from the savings in manufacturing costs, the reduction in planning times may enable new parts to be introduced much more rapidly.

Investigations into the possibilities of the new method were begun on a limited scale in 1959 but the work was rapidly expanded and it is stated that by October, 1960, an estimated saving of nearly 1 million marks (£91,000) had been

Particularly large savings can be achieved where it is possible to establish a flow line for a group of parts which can be kept in continuous operation. Such a line has been provided for the production of five different supports, generally similar to those shown in Fig. 3, for geodetic instruments. Moreover, 15 other parts are also handled on this line. Mention may also be made of a production line for the seven different tubular mounts shown in Fig. 4, for photographic objective lenses. Other projects on which work is now being carried out include a flow line for the production of a variety of gears.

A central Mitrofanov office has been set up, which is now staffed by some 15 engineers, who are responsible for the grouping of existing parts for production with common set-ups on machines, or on flow lines. In addition, drawings of all proposed new parts are submitted to this office to ascertain whether they conveniently fall within—or can readily be adapted to fall within—existing Mitrofanov groups. Efforts are also being

Fig. 5. To avoid the high and rising costs of jigs and fixtures for parts made in small batches, standardized building components are used, including faceplates, angle brackets, swivelling blocks, bolts, nuts, and dowel pins

achieved. It is anticipated, moreover, that additional annual savings of about 600,000 marks (£54,500) will be obtained as a result of the work undertaken this year, and in each of the next two or three years. At the end of that time, the system should be in full operation.

Fig. 6. In each department, area or factory where the method is to be used, space is set aside for the storage of the fixture building parts, and benches are provided for assembly

STANDARDIZED JIG AND FIXTURE SYSTEM

High costs in small batch production also result from the need for individual jigs and fixtures for machining operations on large numbers of different parts. A reduction in these fixture costs has been achieved by the adoption of a so-called unit construction system which enables temporary jigs and fixtures to be built up very easily and quickly. When the work for which a fixture was made up has been completed, it is dismantled and the parts are stored until they are required for use in another fixture. Typical parts for jig and fixture construction are seen in Fig. 5, and they may be used in connection with most conventional machining operations such as drilling, tapping, milling and grinding.

The complete set of fixture parts employed in the Zeiss works is illustrated and described in a small booklet, copies of which were circulated to all departments likely to find the system useful, when it was introduced in 1957. The parts include faceplates with diameters from 6·3 to 31·5 in., in thicknesses from 0·86 to 1·8 in., with various numbers of threaded holes arranged at different spacings. These faceplates are also made with grooved and with T-slotted central portions, to facilitate accurate location of other elements such as angle plates, which are also provided with patterns of threaded holes.

Other items include flat square and rectangular plates, also with patterns of threaded holes, clamping plates, bush holders, V-blocks, swivelling brackets, and special hardened bolts, nuts, washers and locating pins. In those machine shops in which the system is to be used very frequently, an area is set aside for storage of the elements, as seen in Fig. 6, and one or more skilled men are employed specifically for building up the fixtures required. Such fixtures are "designed" on the spot, by the builder, who assesses the work to be performed from the drawing, and decides on the best construction for the jig or fixture.

Various methods of building are adopted, depending on the shape of the part, the operations to be carried out, and the degree of accuracy required. For some work, fixtures may be assembled with the aid of simple measuring tools, but in other instances the use of gauge blocks may be necessary. Each building element has one or more accurately-machined plain bores into which locating buttons may be inserted to facilitate positioning the various parts of a fixture. In Fig. 6, the builder is seen finishing the assembly of a simple drilling jig for producing 11 holes of 0·13 to 0·169 in. diameter near the edges of a flat rectangular plate.

The completed jig is seen in Fig. 7, and it incorporates a rectangular plate from the standard equipment, as a base. Support pieces with rebated edges are bolted to this plate and they serve both to hold the component clear so that the drills do not penetrate into the base, and to locate the part by three of its edges. The fourth edge of the jig, at the right, is fitted with a removable clamping element, held by two of the standard bolts men-

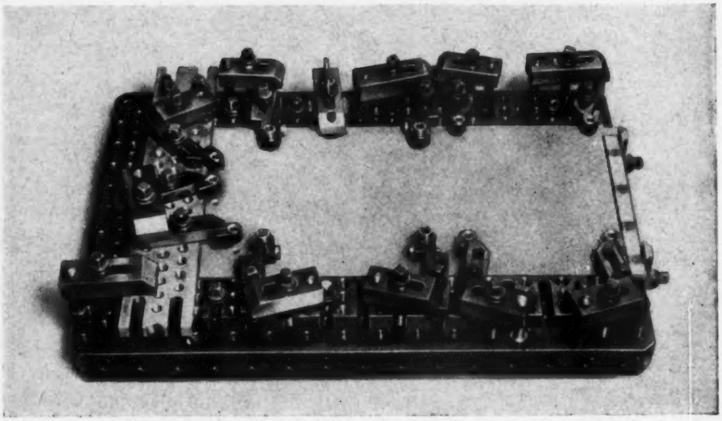


Fig. 7. A close-up view of the drill jig seen in course of construction in Fig. 4, showing the rebated plates which hold the work to be drilled clear of the base plate, and the bush holders which can be fitted with bushes of different bore diameters

and an angle bracket is located by the sides of the grooves and bolted in position. This angle plate forms part of the standardized equipment, and has side pieces with accurately-bored holes which receive bearings for a swivelling block. The edges of the side pieces are marked with angular graduations to facilitate approximate setting to the required angle, greater accuracy being obtained with a sine bar. The swivelling block has a central bore to take the spigot of a smaller faceplate, of 6·7 in. diameter, with edge graduations all round.

tioned above, which can be released for loading and unloading. On top of the rebated support pieces are bolted bush holders, with slotted necks in which can be clamped standard bushes having bores to suit the diameters of the holes to be drilled.

A simple jig such as that illustrated is built in about three hours, and it is immediately dismantled when the operations have been completed. No records of the method of construction are kept, mainly because of the simplicity of the system and because there are so many different applications that record-keeping would be very costly. The system is generally confined to the making of fixtures for batches of parts of less than about 200, special fixtures usually being made where the numbers of parts are larger.

For building fixtures on circular faceplates, particularly where they are to be used on lathes or grinding machines, a pedestal carrying a circular flat plate is provided, as seen in Fig. 8. On this plate is mounted a base carrying two brackets with bearings for a shaft, to the end of which the faceplate can be attached. With this arrangement, the faceplate can be turned to suit the builder's convenience, and fitted with balance weights if necessary. Other examples of faceplate type fixtures are seen on the bench in the foreground in Fig. 8, and an interesting example, which indicates the versatility of the system, is shown in Fig. 9.

Designed to enable holes on opposite sides of a sphere to be bored and spot-faced, this fixture incorporates a circular faceplate of the grooved type,

Fig. 8. For building fixtures on faceplates this pedestal, fitted with brackets to carry a rotatable shaft, is provided. The faceplate can thus be turned, as required, and fitted with balance weights if necessary

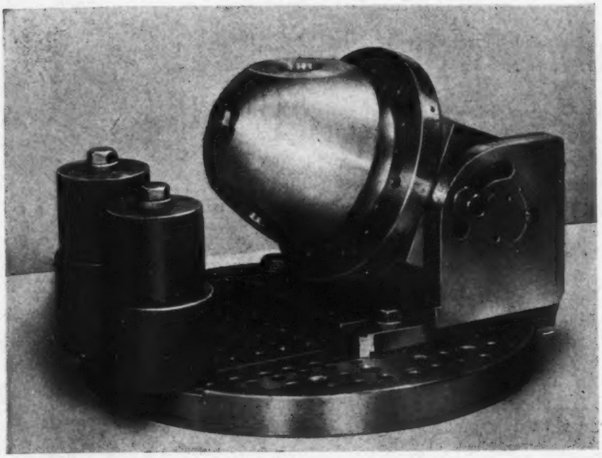


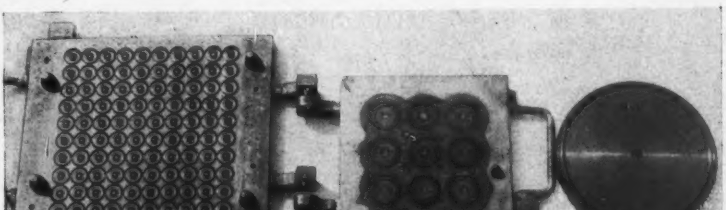
Fig. 9. Details of a faceplate type fixture, designed to hold a spherical component for boring and facing operations on opposite sides. It has been built with standard components from the Zeiss range

A central bolt or stud which passes through the bore of the component serves to secure it to the small faceplate, and the assembly is completed by suitable counterweights. In connection with many fixtures built from the standard components, difficulty is experienced in locating or holding the workpieces, and in such circumstances recourse is made to special parts which are produced on the spot, usually by the equipment builder. Such a part is commonly of simple form, and is labelled with the workpiece number so that it may be kept for re-use when the next batch of such workpieces is to be machined. The complete set of fixture-building equipment contains approximately 1,000 parts, and it is estimated that direct savings amounting to about £22,700 per year are being obtained from the use of one such set at present.

Other aspects of the works practice of the Zeiss organization will be discussed in subsequent articles.

Ultrasonic Cleaning Treatment for Moulds

At the works of Plastic & Rubber Products Co., Los Angeles, California, U.S.A., good results are being obtained from the use of Sonogen ultrasonic cleaning equipment, for the treatment of moulds for rubber products, examples of which are shown in the figure. The process, it is stated, offers particular advantages for moulds used to produce O-rings and lip seals, and for plug type moulds with numerous pins and surfaces which are relatively inaccessible. Certain moulds are of the conventional " book " type, made from low carbon steel and sometimes plated. Others, for use on semi-automatic machines, are made to close limits of accuracy and usually have hardened, chromium plated cavities. For the latter, ultrasonic cleaning is of special value on account of the saving in time and by reason of the fact that risk of damaging the expensive tools is avoided. An alkaline base cleaner has proved most successful.



Examples of rubber moulds before (above) and after ultrasonic cleaning

Making Components for Kopp Variable-speed Units

Some Further Examples of Set-ups and Equipment Employed by Allspeeds, Ltd., Clayton-le-Moors, Lancs.

By A. W. ASTROP, Associate Editor

A RECENTLY-ACQUIRED FACTORY is being employed almost exclusively for the quantity production of Kopp variable-speed units by Allspeeds, Ltd., Accrington, Lancs., the sole selling and manufacturing licencees in this country, and in an article in MACHINERY, 99/616—13/9/61, attention was drawn to some of the principal design features of the unit and to the methods whereby the main drive balls are machined. These balls are made at the rate of approximately 50,000 per year, to serve the needs of Allspeeds, Ltd., and of other licencees throughout the world, including America, and six different sizes—ranging from 1·000 to 3·242 in. diameter—are in continuous production. Limits for sphericity, diameter, and finish are very close. For example, the set of balls in a Kopp unit is required to be of the same diameter within 0·0001 in., and the surface finish must be between 1 and 2 micro-inches.

Mention was also made in the previous article of a component part of the Kopp unit known as the iris plate. This part incorporates three arcuate slots, which serve as cam faces for tilting the drive ball spindles in synchronism, to control the output speed of the unit. The set-up for milling these slots is shown in the close-up view Fig. 1, where a finished iris plate is indicated at *A*, with another, in a different position, adjacent to it. The three arcuate slots are clearly seen, and limits of ±0·001 in. must be maintained on the radius to which each slot is milled, of ±0·00025 in. on the width of the slot, and of ±0·001 in. on the chordal length. Moreover, the distances from the ends of the slots to the periphery of the plate, and to the bore, are held to ±0·001 in.

Such limits are not easily maintained at a small-diameter end-milling operation, and the difficulties are accentuated by the fact that the portion through which the slot requires to be milled is "bowed." As a result, the depth of cut is not continuously uniform and varying deflecting forces are imposed on the cutter. It will be noted that the centres about which the slots are machined are off-set from the bore of the plate, and the set-up shown in Fig. 1 provides for this off-set, also for turning the work through the required number of degrees to suit the chordal length of each slot.

On a Victoria [B. Elliott (Machinery), Ltd.] type V 2 vertical milling machine is mounted a standard rotary table, to which motion is applied by means of the dividing plate and handle seen in the foreground. On this table, and off-set from the centre, is carried a special 3-position indexing fixture, as at *B*, to the top face of which can be secured interchangeable seatings to suit the various sizes of iris plates required. The centre of the rotary table is also off-set from the cutter spindle, and the 2-flute cutter is plunge-fed into the work to produce a starting hole. Subsequently, the rotary table is turned through the required number of degrees, to

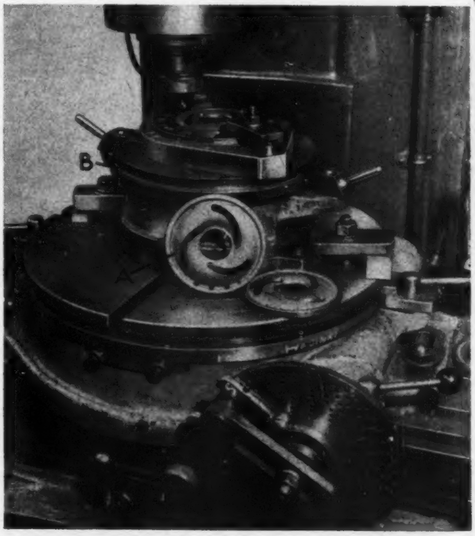


Fig. 1. Set-up on a Victoria vertical milling machine for producing the arcuate slots in iris plates for Kopp Variators

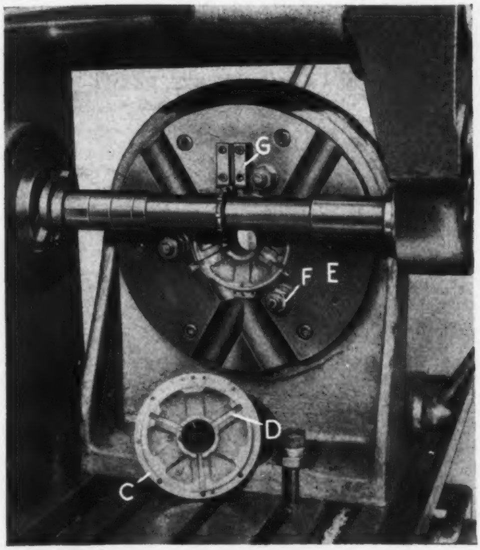


Fig. 2. Guide slots for the main drive ball spindles are plunge-milled at this set-up on an Archdale horizontal milling machine

mill the first slot. The rotation of the table is then reversed, and the cutter is withdrawn. Next, the indexing fixture is turned through 120 deg., and locked, and the procedure is repeated.

The extreme ends of the spindles for the main drive balls are guided in slots in the end covers of the unit, and these slots require to be milled accurately for size and angular spaçing. The bottom of each slot must also be curved, in an arc which approximates to that described by the end of the ball spindle as it is tilted by the iris plate. These slots are machined truly radial to the longitudinal centre line of the unit, and an end cover for the smallest Kopp Variator, with the guide slots finish milled, is seen at *C* in Fig. 2. The three slots, as at *D*, are clearly visible, and another end cover is seen in position in the special work-holding fixture, in readiness for milling the third and final slot. Set up on the table of an Archdale horizontal milling machine, the work-holding fixture is of the angle-plate type, and has a large-diameter bore to receive the body portion *E*. The latter can be turned within the fixture and can be located at 120-deg. increments by means of a lever-operated plunger.

At the centre of the member *E* there is a seating to receive the workpiece, which is loaded from the side remote from the camera and is secured in position by clamps, tightened by means of the nuts *F*. For angular location of the work there is a short dowel, which projects from the back of the member *E* and enters one of the previously-drilled holes in the flange. Screwed and dowelled to the member *E* is a setting block *G*, which incorporates a slot that is 0·020 in. wider than the cutter. When starting on a batch of components, the work-table is lowered to bring this block level with the cutter, and is moved to the left so that the block embraces the teeth. The cutter is then set transversely so that it is central with the slot, a 0·010-in. feeler being inserted at either side.

To machine the slots, the work-table is raised to a predetermined height and is moved to the left, under power, to plunge-feed the work on to the cutter. The table is fed to a dead-stop, which determines the depth to which the slot is machined, and is then retracted so that the member *E* can be indexed through 120 deg. to bring the work into position for machining the next slot. The member *E* is interchangeable with a number of others, with central seatings to suit the various sizes of iris plates which are required to be machined.

For milling the cam faces on drive cones, the set-up shown in Fig. 3, on a Fritz Werner horizontal machine (Rockwell Machine Tool Co., Ltd.), is employed. As described in the previous article, these cam faces serve to apply axial load to the drive cones during service, and to hold them in

Fig. 3. Cam faces on drive cones are milled in two passes with a 2-bank inclined-tooth milling cutter on a Fritz Werner machine

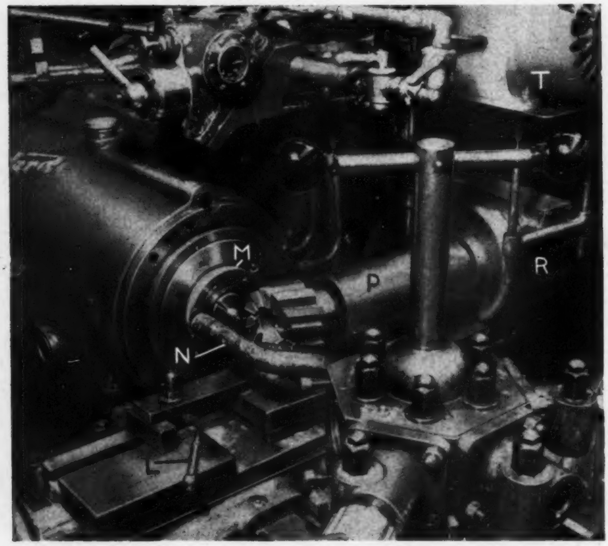


Fig. 4. Ward 2C capstan lathe with a special motor-driven milling attachment mounted in place of the rear tool-box. With this arrangement, main drive ball spindles are finished at one set-up

with the aid of special attachments, which have been designed and built by the company, milling, also transverse drilling and tapping, are performed at the same set-ups, in addition to the more conventional machining associated with capstan lathes. In consequence, significant savings in handling time have been obtained, and in consequence productivity has been increased.

A typical set-up of this kind is shown in the close-up view Fig. 4, where the machine is a Ward type 2C. This lathe is employed for producing the spindles for main drive balls, and a typical component is seen resting on the cross-slide, at *L*. There are various diameter steps on the spindle, and at the end nearer the camera there is a head portion on which two flats are required to be milled. At the first stage, conventional turning operations are carried out on the body of the spindle, and when these have been completed the part is removed from the air-operated collet, reversed end-for-end, and re-loaded.

close contact with the main drive balls in the unit. A finish-milled drive cone is indicated at *H*, and the cam surfaces can be seen on the face which is uppermost. An unmilled cone is in position in the centre of the Fritz Werner indexing table *J*, where it is located by a special seating. It is locked in position by means of the clamp ring *K*, which is internally-threaded and is placed over the work and screwed down by hand. The bore of the ring *K* is stepped, to provide a shoulder which engages with the face of the work, but leaves the central portion—on which the cam faces are to be milled—exposed.

A double-bank McCrosky high-speed steel milling cutter (Geo. H. Alexander Machinery, Ltd.) is employed, which has staggered, inserted teeth, set at the required angle to produce the inclined cam faces. Two passes are made across the drive cone, which is indexed through 90 deg. after the first pass.

COMBINED OPERATIONS ON CAPSTAN LATHES

In the previous article, mentioned above, reference was made to "combined operations" on capstan lathes at the Royal Works. Such operations are carried out on a considerable scale, and

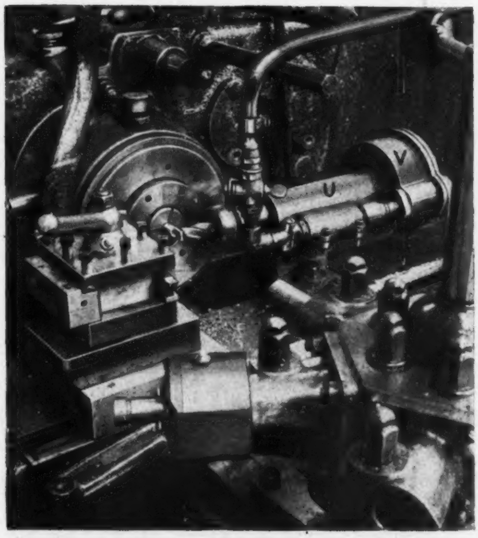


Fig. 5. Another Ward machine is equipped with an air-driven milling spindle, as here shown, for operations on indicator shafts

This sequence has just been completed in Fig. 4, and it will be seen that the head portion of the spindle is projecting from the collet. In the face of the collet retaining ring *M* there are two small diameter holes, which are accurately diametrically-opposed, and these holes are engaged, successively by a conical pip which projects from the end of the curved bar *N*. This bar is secured to one face of the turret, and the latter is advanced to thrust the conical pip into one of the holes in the collet ring, as shown. With this arrangement, the spindle is located angularly, and is prevented from turning.

In place of the rear tool-post, on the cross-slide, there is a milling attachment, which comprises a spindle housing *P*, a worm and wheel reduction unit *R*, and a ½-h.p. driving motor *T*. The motor is carried on a platform which is provided with four legs, arranged to pass through four bosses. These bosses are welded to the ends of two pieces of tube, and the latter are secured horizontally, to each side of the worm unit *R*. Means are provided for locking the legs in the bosses, and with this arrangement the motor platform can be adjusted vertically, to tension the V-belt whereby drive is transmitted to the worm shaft.

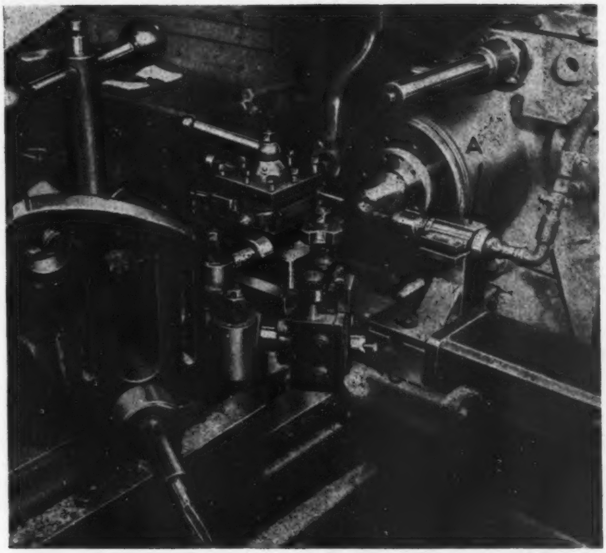


Fig. 6. Transverse drilling and tapping are carried out on this Ward machine in addition to conventional turning and boring operations

A 3-in. diameter, 12-tooth, high-speed steel cutter is employed, and the transverse movement of the cross-slide is used to feed it to the required depth. After one flat has been machined, the cross-slide movement is reversed, to retract the cutter from the work, and the turret is withdrawn slightly to the right, to disengage the end of the bar *N* from the collet ring. Next, the spindle is turned through 180 deg., by hand, the turret slide is advanced to re-engage the bar *N* with the second locating hole, and the milling operation is repeated. The flats machined on these spindles engage the slots in the end covers of the Kopp unit which are plunge-milled at the set-up shown in Fig. 2.

Another Ward 2C lathe is equipped with an end-milling attachment, for operations on the ends of small shaft components, which is shown in the close-up view Fig. 5. The workpiece is an indicator shaft, and two deep flats are required to be machined at one end, to provide a driving tongue. At this set-up, the tongue is milled first, with the aid of the special attachment indicated at *U*. This unit comprises a housing in which the milling spindle is mounted on INA needle-type combined journal and thrust bearings (INA Needle Bearings, Ltd., 34/35 Fitzroy Square, London, W.1). The housing is secured to the cross-slide, in place of the rear tool-post, and to one side is attached a Desoutter Mighty-Atom pneumatic drill. Air is fed from the shop supply to the rear end of the drill and the chuck is used to grip a simple self-aligning coupling. This coupling transmits drive to a small pinion, within the casing *V*, which is in mesh with a gear mounted directly on the end of the milling spindle.

With this arrangement, the required reduction in rotary speed is obtained, and the large gear serves as a fly-wheel. The end of the milling spindle is designed to receive a 3-flute collet-type end mill, and the rear tool-slide is first fed towards the operator to sink the cutter to the required depth. Subsequently, the saddle is fed towards the headstock to mill the flat to the required length. The lathe spindle is held stationary during the milling operation by means of a plunger, which engages with an index plate secured to the rear end. To mill the other flat, the spindle is turned through 180 deg. and the plunger is engaged with another slot. When both flats have been machined, the collet is opened and the bar stock is advanced to a dead stop attached to one turret

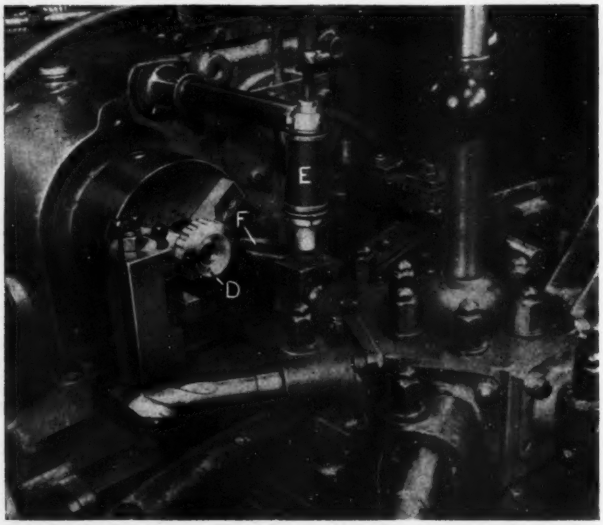


Fig. 7. An air-driven unit on the turret is used to drill an off-centre hole, and taper-turning is carried out from the rear by means of a special attachment

face. The plunger is withdrawn from the index plate, and conventional turning and parting-off operations are carried out.

TRANSVERSE DRILLING AND TAPPING ON A CAPSTAN LATHE

An air-operated unit is also used for transverse drilling operations on a capstan lathe, and a close-up view of the set-up for machining a brass component on a Ward 2C is shown in Fig. 6. The pneumatic drill is indicated at *A*, and is carried in a bracket secured to the rear tool-slide. The workpiece here shown is a bearing bush for a small steel worm, which is employed in some types of Kopp units for adjusting the angular position of the iris plate. The latter has a number of teeth cut on a portion of the periphery, and these teeth mesh with the steel worm.

Axial location is ensured by a ring of small-diameter steel balls, which engage with a groove provided in a plain portion of the worm, also with a similar groove in the bore of the bush seen in Fig. 6. This arrangement also serves to take the end thrust of the worm in operation. The small balls are loaded into the groove by way of a transverse hole in the bush, which breaks out into the internal groove. After the balls have been loaded, the hole is closed off by a brass grub screw, which is retained in position by a wire circlip. The circlip is housed in another groove, in the periphery of the bush, and engages with the screwdriver slot in the screw.

At this set-up, the procedure is as follows. After preliminary turning and boring operations on the bush, the spindle is locked and the unit *A* is fed in to drill the transverse hole to a tapping size. Next, the spindle is indexed through 180 deg., and the hole is tapped. The tap is carried in a small housing clamped in the front tool box, and is rotated by a handle attached to the shank end, as indicated at *B*. Subsequently, the front box is indexed to bring a grooving tool to the working position, and the circlip groove is turned in the periphery of the workpiece. This groove intersects the tapped hole, and when it has been completed a brass grub screw is inserted in the hole and screwed down until the head is flush. Next, the wire circlip is assembled to the workpiece, to secure the screw in position.

The length of the grub screw is such that its inner end is flush with the bore of the bush, and the tool *C*, on the turret, is now applied to machine the ball seating groove in the bore, the groove passing through the plain end of the grub screw. With this arrangement, the ball groove is machined accurately in relationship to the screw-driver slot. As mentioned earlier, the screw is removed to load the balls, and when it is subsequently replaced it is necessary only to engage the circlip to ensure that the groove in the inner end is aligned with that in the bore of the bush. It will be noted that the grooving tool *C* is carried on a slide which is arranged for vertical movement, so that it can be introduced concentrically with the bore of the work and then moved radially to machine the groove to the required depth.

OFF-CENTRE DRILLING AND TAPER-TURNING ON A CAPSTAN LATHE

Some Kopp Variators are fitted with a 4-digit numerical-type indicator, which is used to record particular settings of the iris plate. The indicator is located between the speed control knob and the worm for adjusting the iris plate, and with this arrangement a previous setting, giving a known speed of the output shaft, can rapidly be duplicated by turning the control knob until the required

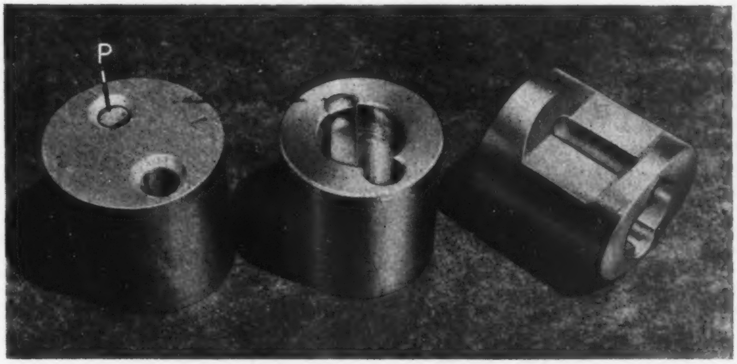


Fig. 9. Three stages in the production of a counter housing incorporating an integral Perspex window

numerical combination is shown. The control knob is of light-alloy extruded bar, and as bought-in it has a number of arcuate grooves in the periphery.

Operations performed on this part include the drilling of a small hole, off-set from the main bore, and machining a wide chamfer at one end. These operations, among others, are performed on a Ward 2C capstan lathe at the set-up shown in Fig. 7, where a workpiece is in position in the chuck. The chamfered portion on the outer end can be clearly seen, as can the grooves in the periphery, and the off-centre drilled hole is indicated at *D*. The hole *D*, which is at the bottom of a counter-bored portion, is machined by the Desoutter Mighty-Atom air drill *E*, mounted vertically on an adapter secured to one face of the turret. This adapter provides a right-angle drive from the air unit, and the drill projects horizontally from the front face, as can be clearly seen in Fig. 8, which is a close-up view of the tools from the operator's position.

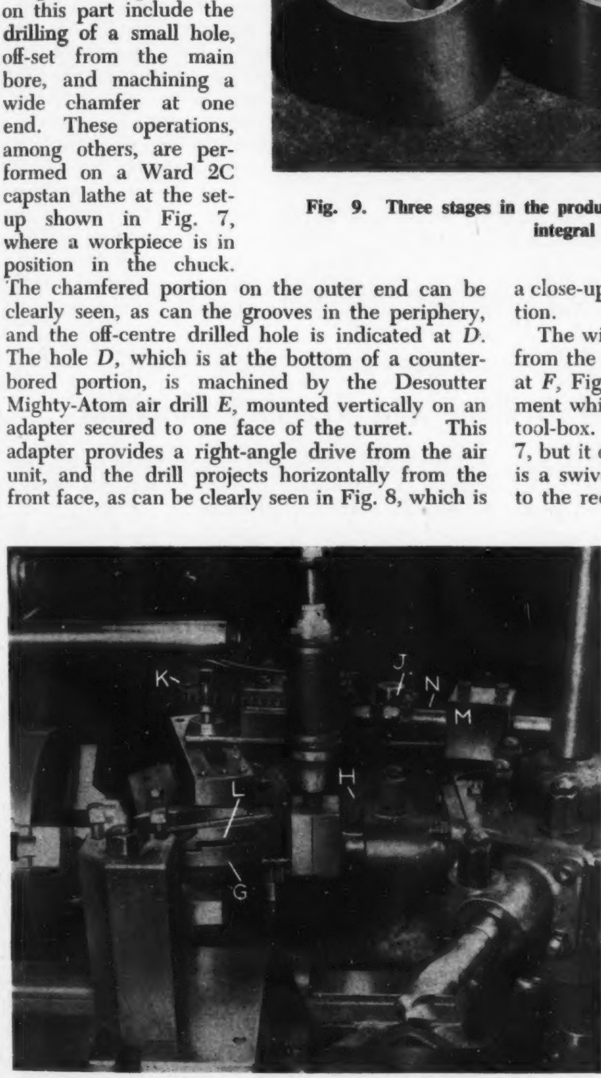


Fig. 8. Close-up view of the special taper-turning attachment seen in Fig. 7

The wide chamfer on the workpiece is machined from the rear slide, by means of the tool indicated at *F*, Fig. 7, and with the aid of a special attachment which is mounted in place of the normal rear tool-box. Part of this attachment is visible in Fig. 7, but it can be seen more clearly in Fig. 8. There is a swivel-mounted member *G*, which is adjusted to the required angle in relation to the centre line of the machine, and secured to the right-hand side of this member there is a cantilever bracket, part of which is indicated at *H*. This bracket serves to support a plate, which carries two vertically-mounted sprockets, embraced by a length of roller chain. The right-hand sprocket, *J* in Fig. 8, is free-running on a stub shaft, but the left-hand sprocket, *K* is keyed to a vertical shaft which extends downwards, through a long slot in the tool-slide.

Another sprocket is keyed to the lower end of the vertical shaft, and engages with a short length of roller chain which is stretched taut and is attached to the under-side of the tool-slide *L*. Supported from one face of the turret, there is a block *M*, with a horizontal bore wherein the rod *N* is clamped. At the left-hand end of this rod there is a sprocket which is secured by a screw passing through its centre, and is prevented from rotating by a second screw, between two adjacent teeth. This sprocket is in

engagement with the outside of the chain which embraces the sprockets *K* and *J*.

It will be appreciated that when power feed is applied to the turret slide, towards the headstock, the sprocket on the rod *N* pushes the chain in a clock-wise direction, as viewed from above, and thus imparts a clock-wise rotation to the sprocket *K*. The sprocket at the lower end of the vertical shaft therefore turns in engagement with the taut chain, and the slide *L* is thus moved towards the operator. Since the slide *L* is set at the required angle, the tool will machine a chamfer on the end of the work.

OPERATIONS ON THE NUMERICAL INDICATOR HOUSING

The counter wheels for the numerical indicator mentioned above are supplied by English Numbering Machines, Ltd., Enfield, and are assembled in the bore of a light-alloy housing which incorporates a Perspex window.

A simple but effective method is used for inserting and retaining this window, and three selected stages from the production sequence for a housing are shown in Fig. 9. The housing is made from bar stock, and at the left can be seen a portion which has been cut off to the required length. Two holes, of different diameters, are drilled in the blank, and in the small hole, at *P*, is pressed a Perspex plug. Cut from rod stock, this plug extends for the full depth of the hole.

At subsequent operations, the housing is faced at both ends, and bored centrally, to bring it to the condition seen at the centre of the figure. It will be noted that the central bore intersects the two previously drilled holes, and that a portion of the Perspex plug is consequently machined away to an arcuate shape. More than 180 deg. of the hole *P* remains, however, so that the Perspex plug is still securely retained. At a final operation, a deep flat is machined in the periphery of the housing, as may be seen at the right. This operation has the effect of producing a sunken rectangular window, and the Perspex is greatly reduced in thickness, with the result that the digits of the counter unit are easily visible.

Numerically Controlled Drilling and Tapping Machine

With the horizontal drilling and tapping machine shown in Fig. 1, which is built by the Barnes Drill Co., Rockford, Ill., U.S.A., it is possible to programme four motions. This 2-spindle machine will perform operations on cylindrical workpieces with diameters up to 36 in. and heights up to 72 in. In addition, it will handle parts of conical, and ogival and certain other curved forms.

The head, which is counterbalanced, has vertical movement on the column, and the latter can be traversed through a maximum distance of 24 in. towards and away from the 40 in. diameter table.

Combination drilling and countersinking or drilling and counterboring operations can be performed, also plain drilling, reaming, counterboring, countersinking, and tapping. Holes can be spaced equally or unequally within $\pm 0{\cdot}003$ in. for true position, and setting can be repeated within $\pm 0{\cdot}0005$ in.

The table, which is powered by a ¾-h.p. motor, can be indexed through 360 deg. at a speed of 1·25 r.p.m. A lifting arrangement comes into operation when the table is to be turned and it is automatically clamped when the desired setting has been obtained.

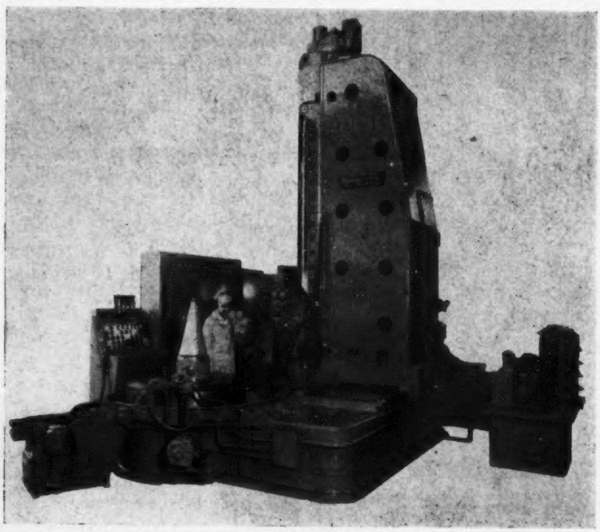


Fig. 1. BarnesdriL numerically-controlled drilling and tapping machine for operations on cylindrical and conical parts

Fig. 2. A close-up view of the machine in Fig. 1 showing the 2-spindle head, the main control panel, and the rack for the pre-set tools

All the rotary positioning is related to a common reference point to avoid accumulation of error, and the same applies to the vertical settings of the spindle head and the horizontal settings of the column.

Positioning is controlled from information punched in standard 8-channel Flex-O-Writer tape, which is coded in decimal form.

Apart from setting, the system provided for automatic control of the various machine functions and gives instructions to the operator. For example, lights on the control panel indicate when tool changes are required to enable different operations to be performed, and the machine will not function unless the specified tool is in the spindle and all other tools are correctly located in the 6-position rack seen at the left in Fig. 2. For depth control, there is a special device which senses the distance that the tool has penetrated from the work face.

When all holes in one row have been completed, the spindle head is automatically re-positioned vertically, and, if necessary, the column is moved in or out.

The Barnes Drill Co. are represented here by Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, Battersea, S.W.11.

Newage Portable Hardness Tester

Metallurgical Services, Reliant Works, Betchworth, Surrey, are now distributors, in this country, for the Newage portable hardness tester, here illustrated, which is made in the U.S.A., and is covered by patents. This instrument incorporates a pre-loaded diamond indentor and to make a test it is only necessary to press the hand grips towards the specimen. Movement of the indentor, as penetration takes place, compresses a diaphragm whereby fluid is forced hydraulically into a capillary tube, and the final position of the fluid indicates the hardness value directly on a scale.

The housing is of brass, with a chromium plated finish, and the nose piece, of hardened steel. Each instrument is hand calibrated with reference to master test blocks, and the dials are individually graduated to ensure accuracy throughout the range. It is stated that readings accurate to 1·5 points Rockwell can be obtained. Instruments are available with ranges corresponding to Rockwell A, B or C, also Brinell ranges of 50 to 260, or 100 to 440.

Newage portable hardness tester which is available for either the Rockwell or Brinell systems

The Production of Printed Circuits and Industrial Nameplates

Methods Employed by Millett, Levens (Engravers), Ltd., and Printed Circuits, Ltd.

By S. C. POULSEN, Associate Editor

IN AN EARLIER ARTICLE IN MACHINERY, 99/592—13/9/61, attention was drawn to some of the methods employed by Millett, Levens (Engravers), Ltd., Stirling Corner, Barnet By-pass, Boreham Wood, Herts., and their subsidiary company, Printed Circuits, Ltd., for producing printed circuits and industrial nameplates. The various processes discussed—which are basically similar for both types of product—included photographic reduction of the oversize master drawing; subsequent duplication of the resulting actual-size master negative, on a "step-and-repeat" camera, to produce multiple-image works negatives; emulsion-coating and contact-printing of circuit-boards and work sheets, also zinc plates for offset litho printing; offset printing of etch-resistant media on to circuit-boards and metal sheets, from the zinc plates; and coating the printed media with bitumen powder, followed by baking, to increase etch-resistance. Reference was also made to the methods used for producing strain-gauges, and other small accurate items, by foil-etching techniques, and to the plant employed for automatic etching and anodizing operations.

AUTOMATIC PROCESSING PLANT

A general view of a recently-installed rotary-transfer automatic etching plant is given in Fig. 1. This plant, which was built to the firm's specification, can be used for etching copper (including circuit-boards) brass, stainless steel, and aluminium, and provided that the processing times are suitably balanced, any three of these materials can be handled simultaneously. A total of 15 radially-disposed carrier-arms is provided, each of which will accommodate three plastics - covered jigs, suitable for sheets or boards up to 18 in. by 24 in., and these arms are raised, indexed, and lowered, to transfer the work from tank to tank.

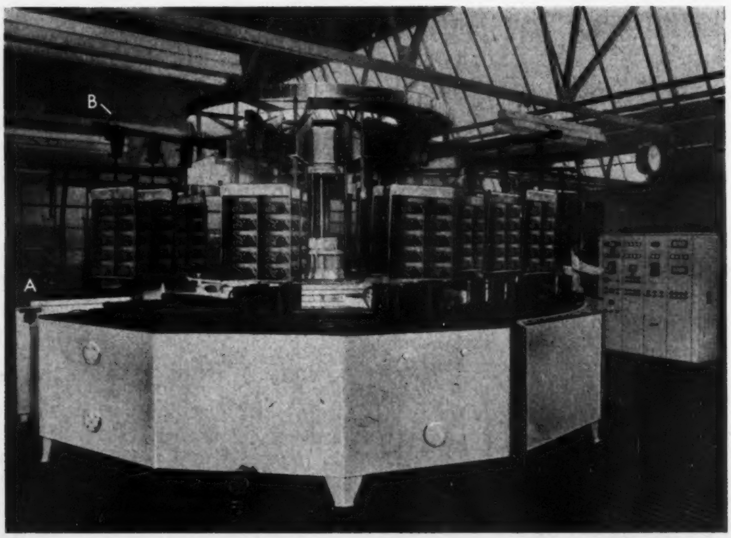


Fig. 1. General view of the recently-installed automatic rotary-transfer plant for etching copper (including printed circuits), brass, stainless steel, and aluminium

The No. 1 main tank, seen in the foreground, contains ferric chloride solution of 35 deg. Beaumé density, which is suitable for copper, brass and stainless steel. This tank is totally enclosed, except for three narrow open channels in the top, which provide the necessary clearance for the shanks of the jigs, and it is provided with 16 impellers that deliver a spray of

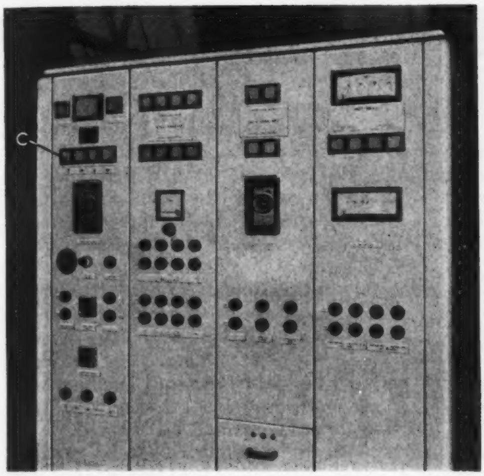


Fig. 2. View of the main control-panel of the automatic etching plant, showing the principal features. The controls for No. 1 and No. 2 tanks are grouped at the left and right

etchant on to the work. The design of the No. 2 main tank, for etching aluminium, is generally similar, and it contains a dilute solution of spent ferric chloride from No. 1 main tank.

Unloading and reloading of the carrier-arms is carried out at station *A*, Fig. 1, and the appropriate processing sequence for the work loaded on each particular carrier-arm is pre-selected by means of a small lever on the outer end. One of these levers is seen at *B*. If the work is to be processed in No. 1 tank, the lever is moved towards the operator, and for No. 2 tank, in the opposite direction. Assuming that the first of these two positions has been selected, the processing sequence is as follows. The work is raised, indexed, and lowered into No. 1 main tank, along which it is then traversed by successive indexing motions. On reaching the end of the etching tank, it is transferred to a cold water spray tank for rinsing.

After the work has been rinsed, it is kept raised during several of the ensuing indexing motions, so that it " skips " the No. 2 main tank, after which, if it is in the form of metal sheets, it is lowered into a chromic acid dip, to remove smut. Circuit-boards, however, are lowered into another solution, at the same station, to strip the etch-resist. At this and similar stations, the different solutions are contained in removable plastics liners, which are placed in the main tanks, and the solution to be used is pre-selected, at the loading station, by locating the work at the appropriate radial position on the carrier-arms.

Following this stage, the work is again spray rinsed, and after the next indexing motion, metal sheets are lowered into a nitric acid dip, contained in another of the plastics liners, whereas for circuit-boards, the station is idle. Next, all work is rinsed in hot water, and is then transferred to a hot-air drying section. Here, the hot air is forced upwards through perforations in the floor of the " tank," and extracted at the rear, near the top. Finally, the dried work is indexed to the unloading station, where the sheets and boards are removed from the carrier-arms at the rate of three every 4 to 5 min., according to the thickness of the copper on the circuit-boards. The processing sequence for aluminium is somewhat simpler. Immediately after the work has been loaded, the carrier-arms are raised, and remain in this position to skip the No. 1 main tank. Etching in No. 2 tank is followed by an idle station, cold rinsing, nitric-acid dipping, hot rinsing, and hot-air drying.

CONTROLS

All controls are centralized on the main electrical cabinet, as shown in Fig. 2, and are grouped to left and right, to correspond, respectively, to the No. 1 and No. 2 series of tanks. The first panel, at the extreme left, incorporates signal-lamps that indicate the various main functions, including a series at *C*, which show, by means of associated arrow marks, the separate motions of the indexing and transfer mechanism. Below this set of lamps, there is an adjustable process timer, whereby the dwells between the transfer motions can be preset to any duration from a few seconds to a maximum of 6 hours. Other controls on this panel are concerned with oscillating motion for tank agitation, emergency stopping, and the selection of " hand " or " auto " operation. In addition, there are various manual controls for use with the " hand " setting. The second panel for the No. 1 processing sequence incorporates signal-lights and controls associated with the spray impellers, and a meter that affords continuous indication of the Beaumé value of the solution in any selected tank.

One panel of the right-hand group gives similar facilities for the impellers of No. 2 main tank, but instead of a Beaumé meter, there is another adjustable process timer, for controlling an auxiliary hydraulic ram. In conjunction with the timer, this ram can be used to raise the work from the No. 2 main etching tank, after a controlled period of immersion, independently of the main transfer mechanism. The immersion period

may thus be shortened, without affecting the processing times at the other stations. Temperature gauges, and adjustable thermostatic controls, for adjusting the temperatures of the hot rinsing and hot-air drying tanks, are mounted on the panel at the extreme right, which is also provided with controls for the electric heaters, and the hot-air fan motors. The entire plant can be run by one operator, who, between loading and unloading the carrier-arms, periodically checks the various functions at the control-panels.

AUTOMATIC DYE-ANODIZING PLANT

A second, generally-similar, plant has been installed by the company, for the automatic anodizing and dyeing of aluminium nameplates and panels. This equipment incorporates a total of 40 carrier-arms, and the processing sequence is as follows. (1) Hot alkaline clean; (2) cold water wash; (3) brightening dip; (4) cold wash; (5) main anodize. During the latter stage, for which a sulphuric acid solution is employed, current is conveyed to the work through the carrier-arms and jigs. For this purpose, the plastics-covered jigs are provided with small clamp-type electrical contacts, that lightly grip the sheets near the edges. The temperature of the bath is thermostatically controlled, and should it exceed a certain value, submerged water-cooling coils are brought into operation automatically.

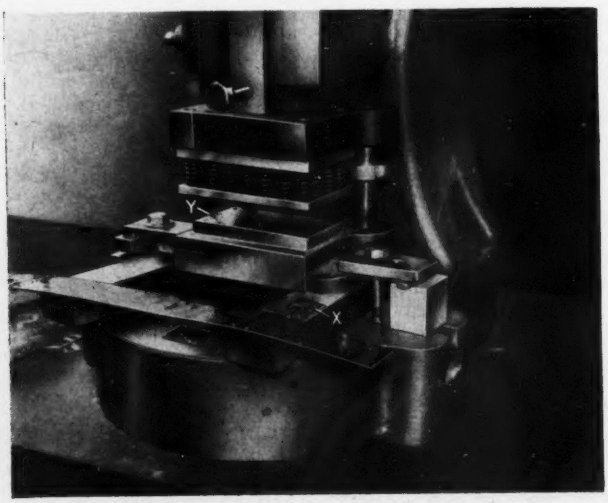


Fig. 3. Typical fly-press tool, for piercing and blanking two small circuits at a time, from the guillotined strip. The output is 1,102 pieces an hour

The various stages that follow the main anodizing process (5) comprise (6) cold water wash; (7) hot air dry; and (8) unload and reload. At stage (8) it may be noted, the anodized sheet is unloaded for transfer to the offset litho printing department, where the pattern of dye resist is applied by the methods already described. Printed sheets, returned from the litho department, are reloaded on to the carriers at station (8), and subsequent immersion in any one of three dye-tanks, during stage (9), is selected by positioning the work radially on the carrier-arm, and by means of an associated push-button. One of the dyes, necessitating a longer period of immersion, is contained in a tank situated towards the rear at section (9), whereas the other two, requiring shorter periods, are at the front. Depression of the button, or omission to do so, selects the front tank into which the work will be lowered.

Immersion in the required dye is followed by (10) cold water wash; (11) strip resist; (12) cold water rinse; (13) seal anodic surface and dye in nickel acetate sealant; (14) hot-air dry; and (15) unload. The mechanical arrangements for skipping certain tanks—for example, for the automatic selection of the dye colour sequence, or the omission of the sealing stage (13) to permit the subsequent addition of other colours—are generally similar to those for the etching plant. In the anodizing tank, both the voltage and the amperage are controlled automatically, and associated equipment on the main panel includes a voltmeter, an ammeter, and a temperature gauge. Corresponding instruments for each of the three dye tanks, all of which are heated and thermostatically controlled, comprise a pH meter and a temperature gauge. As on the control-panel of the etching plant, all the functions in operation at any given time are indicated by signal-lights. The anodizing plant, it may be noted, is readily adaptable for plating operations.

For each plant, all fume-extraction is effected downwardly, through ducts and a ring manifold situated within the circular area enclosed by the tanks. From the manifold, another duct passes beneath the wooden floor-grilles, to an extractor unit mounted on the wall of the shop. The ducting and manifolds are of plastics material throughout, to eliminate corrosion. Safety devices provided for each plant include a set of three prominent signal-lights, similar to traffic-lights.

Green denotes "safe to load"; amber, "caution—machine about to operate"; and red, "keep clear, machine in operation."

"TOOLING" SECTION

As indicated in the preceding article, the various processes employed for the bulk of the circuits and nameplates are such that several of these items are produced simultaneously on each "standard" 24-in. by 18-in. or 20-in. by 18-in. board or sheet. In addition, facilities are available for the production of individual or multiple circuits and panels on boards and sheets of areas up to 25 sq. ft. The subsequent operations of cutting the processed boards and sheets into separate units, and drilling, piercing and blanking the units, as required, are performed in a department known as the "tooling" section. This section, which is provided with tool-making facilities, is also responsible for the forming of various sheet-metal items, machine engraving, and dividing. Equipment available includes guillotines, fly-presses, power presses of various capacities up to 80 tons, and a variety of drilling, milling, and other general-purpose machines.

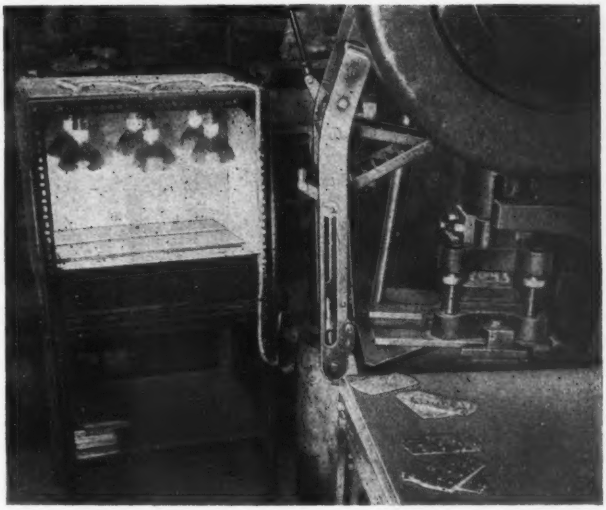


Fig. 4. The heating of certain printed circuits, for piercing and blanking, is facilitated by the use of infra-red lamps, as seen at this power-press station

The procedure followed after processing, by the methods that have been described, differs slightly according to the nature of the product. Whereas the etched circuits and anodized nameplates are transferred directly to the tooling section, etched nameplates are first spray painted, before the resist has been removed, to provide the required background colour in the etched impressions. Next, the work is partly stoved, and the resist is removed by a process termed "padding-off", which entails swabbing with a selective solvent that does not affect the paint. The work is then spray lacquered and fully stoved. Large panels, which will be subjected to extensive work and handling, are spray coated with Birlon strippable protective film.

The methods employed in the tooling section also differ somewhat, according to the product, and are determined by such factors as size, quantity, economic justification for making press-tools, and—in the case of printed circuits—the types of base-materials. These materials, it may be noted, differ widely in thickness, and in suitability, or otherwise, for such operations as piercing and blanking. Typically, the metal sheets are guillotined into strips, from which the individual nameplates are then blanked and pierced on fly-presses. As far as is practical, this procedure is also followed for printed circuits, but where the quantities are insufficient to warrant making press-tools, or the thickness or other characteristics of the base material render it unsuitable for guillotining and piercing, it is sawn and drilled. For work in this category, slots and shaped apertures, that would normally be produced by piercing and blanking, are routed on pantograph engraving machines.

PIERCING AND BLANKING

Much of the work on circuit-boards is concerned with the production of large numbers of small holes, and a typical 2-stage fly-press tool, for piercing and blanking small circuits, two at a time, is shown in Fig. 3, a pair of the pierced and blanked components being indicated at *X*. As may be observed, the punch assembly incorporates a stripper-plate backed by a large number of compression springs, and a total of six guide-pillars is provided, each of which is surrounded by one of the springs. This arrangement ensures that the slender punches are adequately guided and steadied, and that the work is tightly gripped. Firm clamping is particularly necessary, to minimize de-lamination and similar damage to the

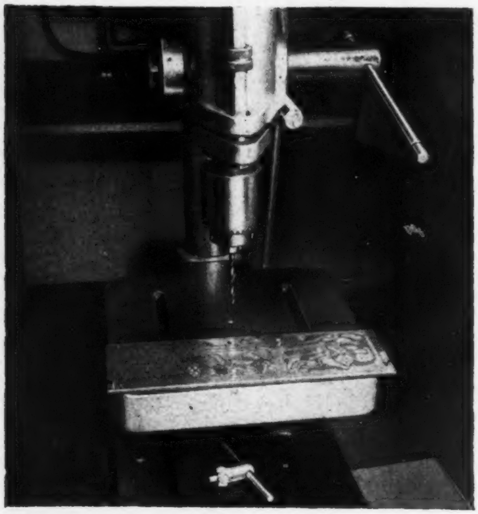


Fig. 5. Typical drilling template, inverted to show the etched replica, produced by printed-circuit technique, which eliminates the necessity for marking-out

base-material, in the vicinity of the holes and blanked edges. The guillotined strip, with tooling holes previously drilled or pierced, is located on the lower tool by means of the pins Y. At the first station, 25 holes of $\frac{1}{32}$-in. diameter, and two of 0·05-in. diameter, are pierced in each circuit. At the second, the components are blanked from the strip, which is $\frac{3}{32}$ in. thick. The output is 1,102 pieces an hour.

Work which cannot conveniently be handled on the fly-presses is pierced and blanked in the power-press section. For certain types of base material, heating is necessary, and a station in the power-press section, arranged for such an operation, on a 30-ton press, is shown in Fig. 4. Next to the operator's position is installed a cabinet incorporating a group of six A.E.I., 250-watt, bell-type, infra-red lamps. Typically, boards are placed beneath the lamps in stacks of about 12 at a time, and are left for 5 to 10 min., to become partly heated. Thereafter, the working interval between the removal of the uppermost board and the next, provides the necessary period for each board, in turn, to reach the required temperature. The example illustrated is a circuit on glass-fibre reinforced base-material, and in this instance, piercing is carried out cold. At the hot blanking set-up, the output is 250 pieces an hour.

Where the quantities involved do not justify the preparation of press-tools, or the material is unsuitable, the circuits are drilled from steel templates, on small single-spindle bench drills. Because of the wide range of hole sizes, and the varying, unsymmetrical positioning of the holes, it may be noted, the use of multiple-spindle heads is impractical. The slow-spiral high speed steel drills employed are ground to a fairly acute point-angle, with little or no back-clearance, so that the tendency to chip or shatter the work on break-through is minimized, and for the smallest size (No. 72) a speed of 4,260 r.p.m. is used.

TEMPLATE PREPARATION

In the preparation of the templates, one of which is shown in Fig. 5, the necessity for marking-out is eliminated by the use of printed-circuit technique. For this purpose, the steel plate is emulsion-coated, contact-printed and etched, in the same way as the circuit-boards, so that a replica of the circuit is reproduced on the surface. This replica then serves as a guide, for centre-punching and drilling, and since it is prepared from the same negative, no extra work is entailed, and exact register of the holes with the copper circuit is ensured. Such templates are usually arranged so that the etched face is in contact with the work, and errors due to drill "wandering," at the template-drilling stage, are thereby minimized. On the upper face, the holes

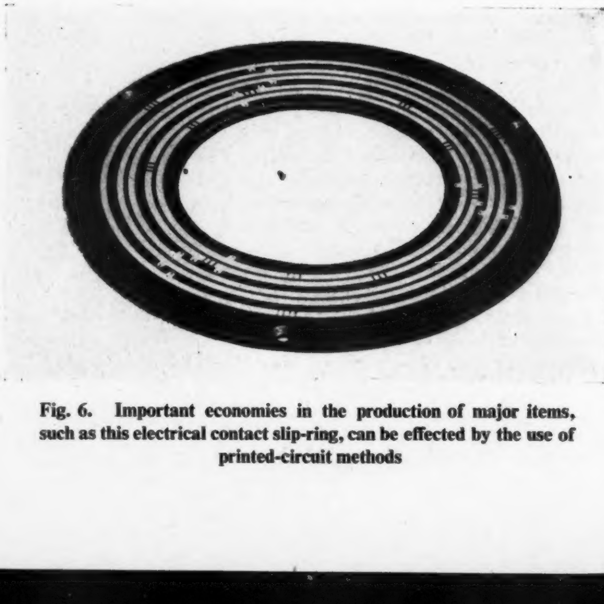


Fig. 6. Important economies in the production of major items, such as this electrical contact slip-ring, can be effected by the use of printed-circuit methods

Fig. 7. The visual inspection of printed circuits on translucent base-materials is facilitated by the use of light-boxes, of the simple design here shown

are marked in accordance with a colour coding system, as an aid to drill-size identification. A similar etched replica technique is used to facilitate the preparation of piercing and blanking tools.

When the various operations described have been completed, any circuits requiring component identification marks are returned to the printing section. Here, the marks are printed on the backs of the boards, either by the offset litho or silk-screen process, the pierced or drilled holes, meanwhile, being used to locate the work. As a precaution against damage to the marks during subsequent handling, the backs of the boards are sprayed with a protective lacquer. Thereafter, the procedure is substantially the same as for unmarked work. The copper face is polished by buffing, and if required, is gold, rhodium, palladium, or otherwise flash plated. Finally, it is sprayed with a flux lacquer, both as a protection against corrosion, and to facilitate subsequent soldering, and the work is then passed to the inspection department.

It may be noted that the various flash coating materials indicated are being used increasingly for printed-circuit switches and contacts. Rhodium, for example, does not tarnish, and when used with gold- or palladium-alloy brushes, affords several advantages, which include low electrical contact-resistance, and long working life. Integral components of these materials are readily incorporated in printed copper circuits, with corresponding savings in space, and in production and assembly costs. Similarly, individual components, which normally require machining and other work, can frequently be produced more economically, by the use of printed-circuit methods. An example is the large electrical contact slip-ring, for a printing machine, shown in Fig. 6. This item comprises an insulating base of ⅜-in. plastics material, of approximately 15 in. diameter, with a series of rhodium-plated copper conductor bands. For multiple-contact switching applications, the metal portions can be made flush with the surface of the base material, to minimize friction and wear, by means of a "flush bonding" technique entailing the use of epoxy resin.

INSPECTION

In the inspection department, all checking is carried out visually, by women, and where the circuits are on translucent base-material, this work is facilitated by the use of light-boxes, as shown in Fig. 7. Typical defects for which the work is examined include discontinuities in, and "bridging" between, the copper lines. The commonest causes of discontinuities are foreign matter, dust, or other flaws in the resist, which result in under-

Fig. 8. Where the quantities justify the preparation of such equipment, small electrical testing jigs are used for checking certain types of printed circuits

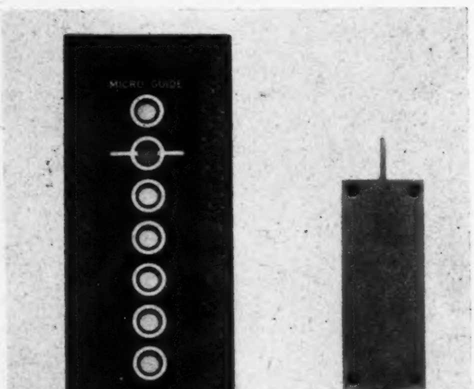
cutting at the etching stage. Bridging is usually the result of the flowing-together of certain portions of the resist, either during printing, or subsequent bitumen coating and baking. For certain types of circuits, and where the quantities justify the preparation of such equipment, the work is checked on low-voltage electrical test jigs of the design shown in Fig. 8.

The work is located, copper face downwards, in engagement with contacts that protrude from an insulating surface, as seen at Z, and " shorts " and discontinuities are indicated by the illumination, or failure to illuminate, of the associated signal-lamps. Jigs of this design are readily prepared by fitting one of the circuit-boards with the necessary contacts, the latter being provided by inserting small screws through the holes in the board, and securing them with nuts on the copper face. Alternatively, the screws may be soldered to the copper. The particular circuit seen in Fig. 8, it may be noted, affords an example of integral printed-circuit components. It comprises a television " triplexer " for Wolsey Electronics, Ltd., and incorporates four high-frequency inductors.

Paramatic Micro-Guide Workpiece Sizing Equipment

The Micro-Guide equipment shown in the illustration, has recently been introduced by Paramatic Developments, Ltd., Canal Street, Derby, to provide a convenient means of controlling workpiece size during the final stages of machining. It is stated that it may be used to particular advantage on worn machine tools.

A single, sealed, measuring, head as shown on the right-hand side of the figure, or, alternatively, two heads, may be connected to the indicator unit, which is intended for operation from a single-phase power supply, and is normally mounted in a convenient position for viewing by the operator.



Paramatic Micro-Guide workpiece sizing equipment which may be used on worn machine tools

Coloured lamps, arranged vertically on the indicator unit, are lit in turn by deflection of the stylus arm on the measuring head sideways in either direction, through built-in contacts. Holes are provided in the 4-in. long body to take screws for fixing the measuring head to a machine.

The lowest (green) lamp is lit by deflection of the stylus arm when the workpiece has been brought to within 0·025 in. of the required size, for instance, after a rough machining operation, and, at the same time, a buzzer sounds.

This lamp remains illuminated while machining proceeds, and when the work has been brought to within 0·005 in. of the desired size, it is extinguished, and the next (amber) lamp is lit. Other amber lamps are illuminated, in turn, as the workpiece size is reduced by steps of 0·001 in., and when the required dimension has been obtained, a red lamp is lit. In the event of the workpiece being accidentally machined under-size by 0·001 in., the topmost (blue) lamp is lit, and a warning bell rings. If required, provision can be made for the lamps to be lit as the workpiece size is reduced in increments of less than 0·001 in.

When the equipment is employed on a turret lathe, for example, the length stops for the turret slide may be adjusted individually, so that they deflect the stylus arm on the measuring head to illuminate the red lamp at the end of each cutting stroke. A second measuring head may be connected to the same indicating unit, and operated by other stops during the final part of the cutting stroke of the cross slide in either direction. The equipment may also be used for sorting workpieces for size, monitoring automatic machining operations, checking the positions of components in jigs and fixtures for accuracy, and on centre lathes which are set up for machining batches of work. An adjustable contact arm is available for centre lathe applications.

Boeing Plasma Laboratory

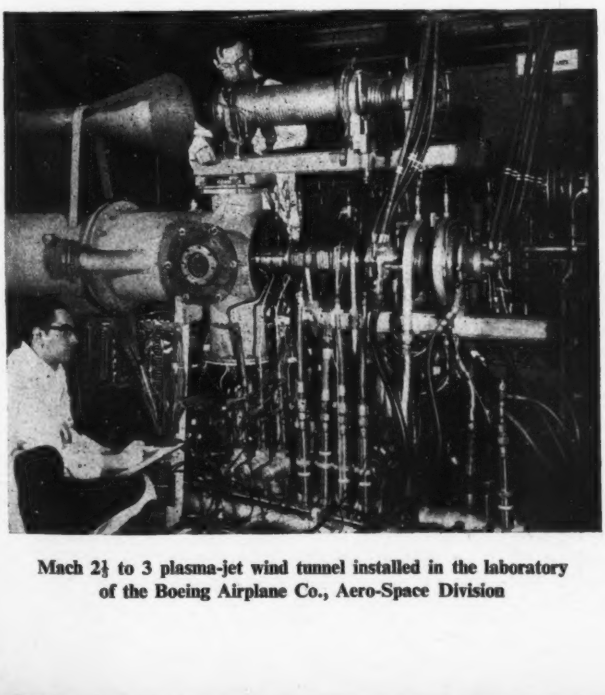
The Aero-Space Division of the Boeing Airplane Co., Seattle, Washington, U.S.A., have recently established a plasma laboratory to develop methods of producing high-velocity jets of pure air at high temperatures, which can be maintained for considerable periods. Recently, it is stated, a 1-MW. arc-type plasma-jet wind tunnel was operated continuously for 33 min. with uncontaminated air. Such facilities, it is pointed out, will be of great value in connection with the testing of nose cones, leading edges and other surfaces of missiles and space vehicles under re-entry conditions.

For early plasma jets, electric arcs between carbon electrodes were employed, but the carbon burned away rapidly and impurities were introduced into the jet stream. This difficulty has been overcome by the adoption of copper tube electrodes with water cooling, which have long life and do not pollute the jet. These copper tube electrodes may take the form of opposed rings of equal diameter, or concentric rings. Electrodes of oblong shape can also be used where broad, thin jets are required for testing wide models such as wing leading edge sections.

The electrodes are located at a distance of 1 to 2 in. apart, and are connected by several pieces of fine wire. When starting up, a 2,200-lb. per sq. in. air supply is first connected to a pipe leading to the electrodes, and cooling water, at a pressure of 600 lb. per sq. in., is circulated at the rate of 240 gal. per min. through the electrode tubes and into a separate system of copper coils enclosing other equipment which must be cooled. Next, a 4,000 amp. d.c. supply is switched on to energize the electrodes, and the wires between them vaporize in a flash explosion, which forms a plasma. This plasma is a conductor of electricity and the arc continues to flow, from a spot on one electrode to a spot on the other.

Owing to the intensity of the heat, the copper becomes liquid at the points of contact of the arc. Rupture of the tubes is prevented by a magnetic field which is induced around the electrodes by current flowing in water-cooled copper coils. The magnetic field causes the points of arc contact to move around the copper tube electrodes at high speed, and molten spots on the tubes harden instantly after the arc has passed.

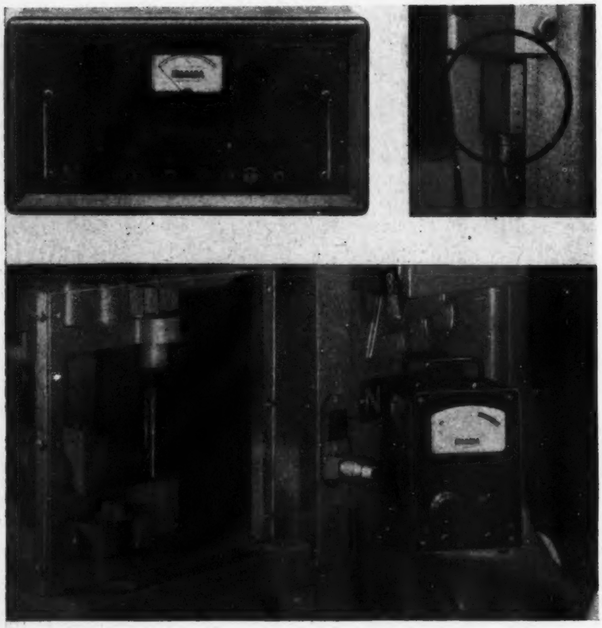
The Mach 2½ to 3 plasma jet tunnel shown in the accompanying figure, which is now in operation, incorporates vacuum equipment capable of simulating altitudes up to 95,000 ft. Temperatures of the circular plasma jet of this tunnel are estimated to be 20,000 deg. F. at the core, and 12,000 to 15,000 deg. F. at the perimeter. A Mach 5 to 7 plasma jet wind tunnel, with altitude simulation up to 200,000 ft., is under construction.



Mach 2½ to 3 plasma-jet wind tunnel installed in the laboratory of the Boeing Airplane Co., Aero-Space Division

Niagara Load-measuring Instruments for Presses

Niagara Machine & Tool Works, Buffalo, N.Y., U.S.A., who are represented in this country by Wickman, Ltd., Fletchamstead Highway, Coventry, have recently introduced two electronic instruments for measuring the loads imposed when presses are in operation. As a result, risk of damage due to overloading can be avoided. The No. 112 "Load Monitor," shown at the upper left in the figure on the next page, serves to indicate continuously the load on a machine—from 0 to 140 per cent of the rated capacity—and it is stated that the speed of response and accuracy are not affected by the working rate. A special tripping circuit is



For indicating continuously the load applied during operation of a press, the Niagara No. 112 Load Monitor (upper left) is connected to pick-up heads on the machine (upper right). The portable No. 119 Tonmeter (lower view), when plug-connected to a pick-up, shows the maximum load during a working cycle

provided, whereby the clutch in the drive system for the press is disengaged when the loading rises to a pre-determined percentage of the capacity, and, if required, arrangements can be made for the simultaneous operation of a warning signal. There is provision for locking the setting controls, to prevent unauthorized adjustment. The unit is connected to two or four pick-up heads, which are attached to the tie bars or frame of the press, as seen at the upper right in the figure, and can be arranged well clear of the die and feeding areas.

The battery-powered, portable, No. 119 Tonmeter, seen in the lower view, is designed to indicate the maximum load on a press during the operating cycle, also for use when setting up. For checking, the trailing lead from the instrument is connected to a socket on a pick-up head mounted on the frame of the machine. A dial provides for setting in accordance with the capacity of the press, and the response is not affected by the working rate.

New Autoset Swivelling Wheel Unit

Autoset (Production), Ltd., 76-82 Stour Street, Birmingham, 18, have recently added to their range the swivelling wheel unit seen in the figure, which is designed to carry dynamic loads up to 2 tons. The twin, 10-in. diameter, rubber-tyred wheels are mounted on needle roller bearings, which run on a hardened and ground shaft and each wheel has an individually-adjustable, internal expanding, brake, of 6¼ in. diameter. These brakes are applied by means of a cantilever arm, which is heavily spring loaded, and are released by the upward movement of a rod that extends axially through the vertical swivel pin. The lower end of the rod is located in a universal ball arrangement on the arm. Taper roller bearings are incorporated in the swivelling head, and the wheel carriage may be locked in four angular positions by means of a spring-loaded plunger.

Towing lugs are provided, and two units can be connected together for steering by the Ackerman system.

Autoset swivelling wheel unit, for carrying dynamic loads up to 2 tons

7th European Machine Tool Exhibition-Brussels FOURTH ARTICLE

FRONTOR 40 FRONT-OPERATED SINGLE-SPINDLE CHUCKING AUTOMATIC

The West German firms of J. G. Weisser Soehne and Maschinenfabrik Diedesheim G.m.b.H. (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex), jointly developed the front-operated automatic chucking machines, which are marketed under the name Frontor, and are available in two sizes. The Frontor 40, shown in Fig. 1, is made by Maschinenfabrik Diedesheim G.m.b.H., and has a maximum turning capacity of $19\frac{11}{16}$ in. diameter. The smaller, Frontor 25 machine, with a capacity of $10\frac{13}{16}$ in., is built by J. G. Weisser Soehne, and is of generally similar design.

On the Frontor 40, drive to the headstock is taken by belt, through an electro-magnetic clutch and brake unit, from a motor which may range from 10 to 27 h.p. according to requirements. Spindle speeds from 35 to 1,400 r.p.m. can be provided, and if a small range will suffice, the speeds are obtained by change gears, and the ratio between the final gear shaft and the spindle is fixed.

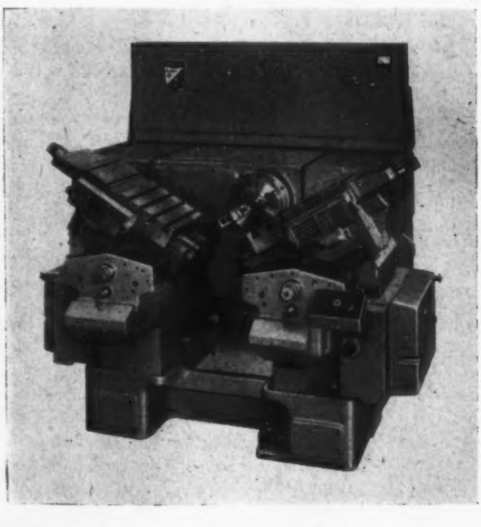


Fig. 1. Frontor 40 single-spindle chucking automatic for turning up to $19\frac{11}{16}$ in. diameter

To provide a wider speed range, sliding gears are incorporated in the drive. All the gears are of high-tensile steel, heat-treated and ground. The main spindle gear runs in an oil bath, and the remaining gears are splash lubricated.

The spindle is mounted in double tapered roller bearings and a hydraulic chuck, which may be of $9\frac{7}{8}$, $11\frac{13}{16}$, or $15\frac{3}{4}$ in. diameter, is mounted on the flange, as close as possible to the front bearing. If two spindle speeds are required during the cycle, a pole-changing motor can be fitted. Alternatively, steplessly-variable control, either by a d.c. motor, or a mechanical unit, can be provided, and several spindle speeds can then be obtained during a cycle.

Right- and left-hand tool slide units may be of the same or different types, that most commonly fitted having a transverse travel of $8\frac{1}{2}$ in., and a longitudinal travel of $9\frac{3}{4}$ in. The slide units can be set at different distances, in increments of 4 in., from the chuck face. A choice of slide units is available, that designated type L having hydraulically-actuated longitudinal movement and a screw-operated transverse motion. With the type P unit, this arrangement is reversed. A type LP slide unit has hydraulically-actuated motions in both directions, for working to stops, and with the LK unit, hydraulic copying facilities are available in the longitudinal direction. There is also a type LPK tool slide with provision for hydraulic copying in both directions of travel, and, if desired, a slide arrangement can be supplied which permits longitudinal and transverse copying as well as turning to stops. Feed rates are steplessly-variable from [illegible] to $19\frac{11}{16}$ in. per min.

Control of the feed rate is normally obtained by throttling the flow of oil, but if a constant cutting speed control is provided for facing, variable speed pumps, driven from the work spindle, are employed to maintain a constant feed per revolution. The electric and hydraulic controls for the tool slides are housed in boxes on each side of the bed, and push-buttons for the individual motions are incorporated to facilitate setting up the

machine. A punched card control system can also be applied, and automatic work loading and unloading mechanism is available if required.

HATEBUR NUT FORMING AND COLD HEADING MACHINES

Machines built by F. B. Hatebur, Basle, Switzerland (P. A. Mead, Ltd., 3 Vincent Parade, Hanley Road, London, N.4), for cold forming blanks for hexagon nuts in sizes up to 17 mm. (0·7 in.) across flats, also other components, such as screw plugs and rollers for chains, have recently been the subject of some design improvements, and the latest type PKE-10 pre-forming machine, and type PKZ-1 multiple-station press for finish forming, are shown, respectively, in Fig. 2 and Fig. 3. On the first of these machines, slugs of the required volume are cut from cold drawn steel bar, and the hexagon shape is formed, also a chamfer at one end. At the same time, the end faces are formed accurately parallel. Following annealing, and, if required, other processes such as barrel finishing and phosphating, the partly-formed blanks are delivered to the press by way of a hopper feed unit.

At the first working station on the press, the central hole is formed from both ends of the blank for a depth which leaves a thin central web, and a second chamfer may be produced if desired. The blank is now moved to the next station by a transfer mechanism, and the web is then punched out to clear the hole. Another transfer movement brings the blank to the third working station, where both ends of the hole are chamfered. The machines have a capacity for producing blanks at the maximum rate of 130 per min.

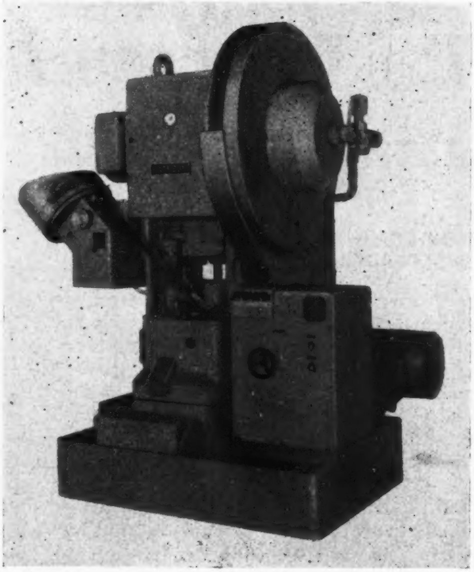


Fig. 3. Following annealing, partly-formed nut blanks are delivered to this Hatebur type PKZ-1 multiple-station press for finish forming

An entirely new, type BKA 2, automatic progressive cold heading machine will be shown, which has a capacity for producing blanks for bolts and other components from steel bar up to 14 mm. (0·55 in.) diameter. Blanks for ⅜-in. diameter bolts, for example, can be produced on this machine at the rate of 120 per min. A maximum of four cold forming operations may be carried out on the work during the operating cycle, and each piece cut off from the bar is brought to the first die by continued movement of the cutting-off slide. The gripper jaws on the mechanically-operated transfer mechanism can be adjusted independently for opening and closing, and the ejectors can be set separately, to suit the individual stages of the forging operations.

The machine is driven by a variable-speed motor, through an electro-pneumatic clutch and brake unit,

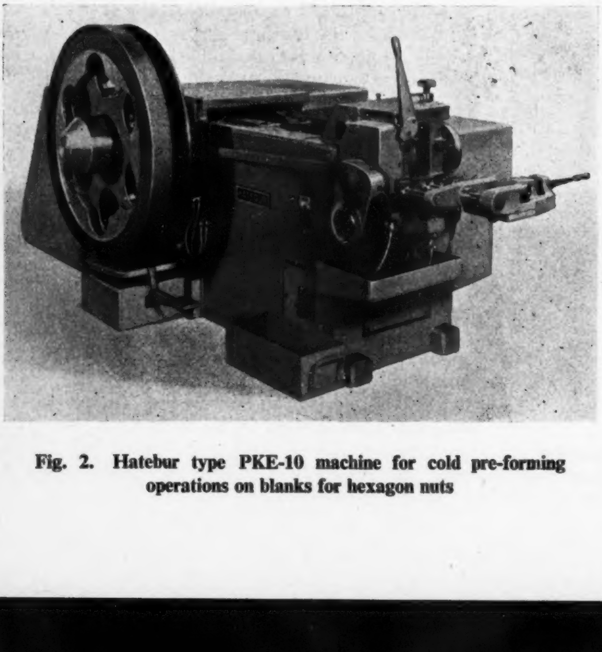


Fig. 2. Hatebur type PKE-10 machine for cold pre-forming operations on blanks for hexagon nuts

which is operated by push-buttons on the control desk. Various safety arrangements are incorporated, which are arranged to operate a micro-switch to de-energize the clutch if a pre-set load is exceeded during forging. A very slow motor speed is provided which enables the tool slides to be " inched " to facilitate setting up.

PFAUTER TYPE P. 2300 GEAR HOBBING MACHINE

The type P. 2300 gear hobbing machine, shown in Fig. 4, from the range built by Hermann Pfauter, Ludwigsburg, Württ., Germany (Vaughan Associates, Ltd., 4 Queen Street, Curzon Street, London, W.1), is of similar design to the type P. 1800, but of larger capacity. It enables gears up to 92 in. diameter, with a maximum of 1½ d.p., and numbers of teeth down to 12, to be cut in steel of 38 tons per sq. in. tensile strength. If required, the machine can be supplied for cutting gears with numbers of teeth down to 6. The capacity for face width is 30 in. for spur gears, and 27½, 16, and 10 in. for gears of the largest diameter that can be handled on the machine, which have helix angles of 30, 45, and 60 deg. respectively.

As with other machines in the P range, the column which carries the universal hobbing head is moved towards and away from the cutting position on guideways at the left-hand end of the bed. Setting for depth of cut is made with reference to a micrometer dial mounted on the control panel built into the column. A tailstock, which can be adjusted vertically, and locked in the required position, is mounted on guideways on a column at the other end of the bed, for supporting the upper ends of mandrels or shafts integral with gears, when fairly small-diameter workpieces are to be handled. The tailstock arm is of split design, and the component parts can be swung outwards clear of the working area by means of a handwheel on the column, when large-diameter gears are to be cut. Since the columns are of massive proportions, the need for an overarm is avoided, and there is a clear space above the working area to permit large-diameter gears to be readily loaded and unloaded by means of a hoist.

Hobs up to 11½-in. diameter with a maximum length of 13 in. can be employed on the machine, and the total hob shift movement obtainable is 12 in. Drive is taken from a 19-h.p. motor, and the hob speeds can be varied steplessly from 25 to 150 r.p.m. The feeds, which, again, can be varied steplessly, range from 0·014 to 0·283 in. per table rev. vertically, and from 0·003 to 0·060 in. per rev. in the radial and tangential directions. Spindle speeds and feeds can be adjusted while cutting is in progress, if required, by means of dials incorporated in a pendant control unit which can be housed in a recess in the left-hand column or swung to a convenient position. Rapid power traverses are provided for the various motions on the machine, and the 55-in. diameter table can be rotated continuously at speeds ranging from 1 to 6 r.p.m. to facilitate setting a blank concentric with the axis of rotation.

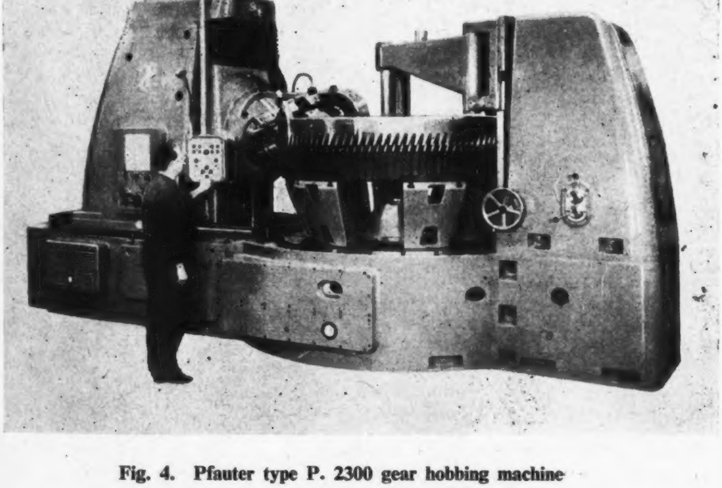


Fig. 4. Pfauter type P. 2300 gear hobbing machine

The machine can be set for gear cutting by the Pfauter diagonal hobbing method in which vertical and tangential feeds are applied simultaneously to the hob saddle and spindle. This arrangement provides, in effect, a continuous hob shift movement so that uniform wear of the cutting edges is obtained. The ratio between vertical and tangential feeds can be varied by means of change gears. Conventional and climb hobbing can be carried out on an automatic cycle, and for

climb cutting, backlash between the screw and nut of the vertical feed is eliminated by a patented hydraulic arrangement.

ACIERA TYPE TR33 CO-ORDINATE POSITIONING TABLE

Aciera S.A., Le Locle, Switzerland (Adam Machine Equipment, Ltd., St. Peter's Street, St. Albans, Herts.), have introduced the type TR33 co-ordinate positioning table shown in the drawing, Fig. 5, for use on a vertical drilling machine. It has a T-slotted working surface measuring 22 by 15½ in., with longitudinal and transverse movements of 11 and 7½ in. Adjacent to the working surface, on the left, there is a glass covered frame *A*, to hold an 11½- by 8-in. drawing whereon are shown the positions of holes required in the workpiece.

A master positioning plate *B* is attached to the under-side of the table and is provided wth a number of accurately located, hardened and ground pins, as at *C*, which have pointed ends. The table moves freely on hardened and ground rollers in the longitudinal and transverse directions, and it is manœuvred until a spot of light, which is visible through the drawing, appears near the selected hole. A lever *D* is then moved to the right so that the cam block *E* lifts the plunger *F* into engagement with the selected pin. This plunger has a mating conical recess, and the table is thus located in the required position. The lever movement also clamps the table securely in both directions of travel.

One master plate can be provided with pins for a number of workpieces, since for each piece a drawing is used as a guide for pin selection. In one instance, for example, one plate was provided with 194 pins for 33 different workpieces. The minimum distance between hole centres is ⅜ in. It is stated that, under normal conditions, an accuracy of positioning of 0·0004 in. can be achieved. The overall height of the unit is 10¼ in., and it weighs 3 cwt.

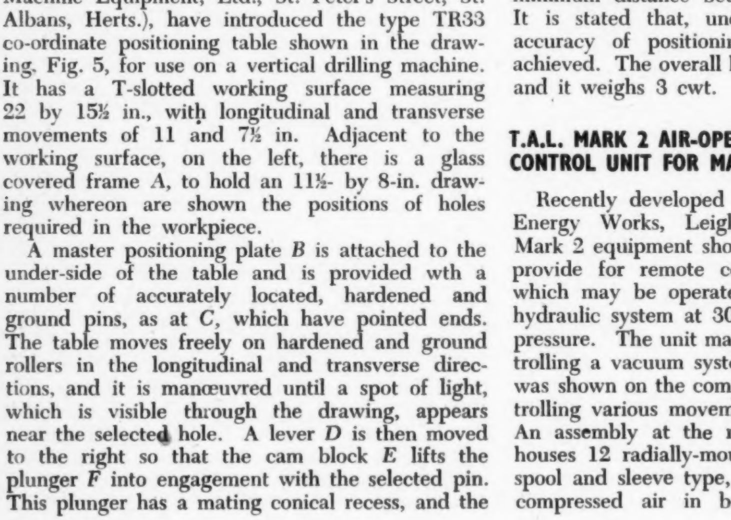


Fig. 5. Perspective sectional view of the Aciera type TR33 co-ordinate positioning table for use on a vertical drilling machine

T.A.L. MARK 2 AIR-OPERATED CONTROL UNIT FOR MACHINE TOOLS

Recently developed by T.A.L. Numatics, Ltd., Energy Works, Leighton Buzzard, Beds., the Mark 2 equipment shown in Fig. 6 is intended to provide for remote control for a machine tool which may be operated by compressed air or a hydraulic system at 300 lb. per sq. in. maximum pressure. The unit may also be employed for controlling a vacuum system down to 30 in. Hg. It was shown on the company's stand set up for controlling various movements on a milling machine. An assembly at the right-hand end of the unit houses 12 radially-mounted valves of the lapped spool and sleeve type, which can be operated by compressed air in both directions, or in one direction only, with spring return. These valves can be employed for controlling a maximum of six double-acting cylinders which can be brought into operation in any desired sequence.

At the end of a particular stage of the operating cycle of the associated machine, one of the cylinders operates a limit valve, with the result that compressed air is passed by means of a 4-way spool-type valve to a double-acting cylinder incorporated in the unit. Operation of this cylinder causes a central assembly to be indexed through an angle of 30 deg. to initiate the next stage in the working cycle. This

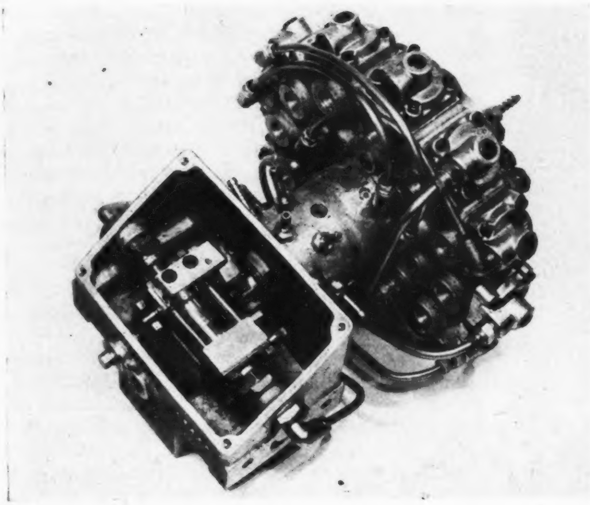


Fig. 6. T.A.L. Mark 2 air-operated control unit for machine tools

arrangement ensures that one stage of the operating cycle cannot be started until the preceding stage has been completed. The unit can be supplied with holes threaded ⅜-, ½-, or ¾-in., to take connections for pipes for compressed air or pressure fluid.

GEFRA TYPE D 2 CAPSTAN LATHE AND ADJUSTABLE BORING HEADS

Shown in Fig. 7, the type D 2 capstan lathe built by N. V. Machinenfabriek Gefra, The Hague, Holland (Funditor, Ltd., 3 Woodbridge Street, London, E.C.1), has a centre height of 4 in., and the length of the bed is 29½ in. A lever-operated parting-off slide is mounted on the vee and flat bedways. Drive is taken from a 2-speed motor, of 1·3/2·2 h.p., through a flat belt and stepped pulleys, and the 8 spindle speeds obtainable in each direction range from 175 to 3,000 r.p.m. Mounted in angular contact ball bearings at the nose end, and a roller bearing at the rear, the headstock spindle is bored ¾ in. diameter, and will take collets up to ¾ in. capacity, also a 5-in. diameter 3-jaw chuck. There is a single lever on the headstock for opening and closing the collet and operating the clutch and spindle brake, also separate switches for selecting the motor speeds and reversing the spindle drive. A type D 1 lathe of similar capacity is available, which has a lever-operated tailstock, and a screw-operated swivel compound slide fitted with front and rear tool-posts. The spindle is bored 1·1 in. diameter, and will take a 3-jaw chuck only.

The Gefra type D 13 motor-driven spindle unit can be employed as an independent item, or it can be mounted on a bed member which has vee and flat guideways for a saddle and tailstock, to form a lathe with a centre height of 3·94 in. This bed member is available in different lengths which enable a maximum of 7·87 or 13·78 in. to be admitted between centres mounted in the spindle and tailstock. The centre height of the spindle unit is 5·9 in., and drive is taken from a 0·8-h.p. motor through a belt and stepped pulleys. Spindle speeds of 1,300, 2,600 and 4,000 r.p.m. are provided in either direction. The spindle is bored 0·79 in. diameter, and will take collets up to 0·47 in. capacity.

Adjustable boring heads are made by the company in two sizes, and an example is shown in Fig. 8. The cutter slide can be adjusted for a maximum distance of 11/16 in. on the smaller boring head, and 1½ in. on the larger size, and a micrometer dial is fitted for accurate setting. Each head can be supplied to take a ¾-in. diameter boring bar or an off-set bar,

Fig. 7. Gefra type D 2 capstan lathe

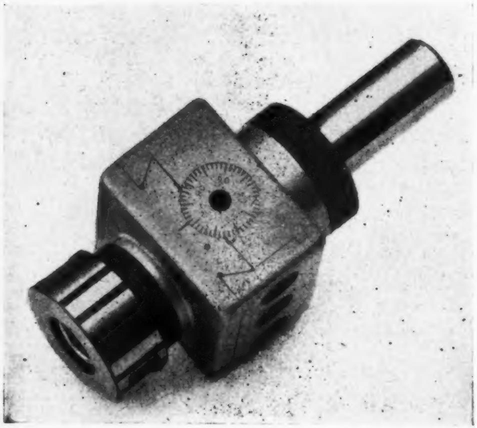


Fig. 8. One of the Gefra adjustable boring heads, which are available in two sizes

which will accommodate 6-mm. (0·236-in.) square tool-bits. When an off-set bar is fitted, cuts can be taken on diameters up to 6 or 7¾ in., depending upon the size of the head. Alternatively, the heads can be supplied, as shown, to take interchangeable rubber collets with steel gripping pieces. Boring bars of different diameters from 0·193 to 0·480 in. for the smaller head, and from 0·098 to 0·748 in. for the larger size, can then be held. With a third design, the bore for accommodating a boring bar or a rubber collet is off-set from the centre line of the shank, when the cutter slide is set in the central position, by 8 mm. (0·315 in.) on the smaller head, and 12 mm. (0·472 in.) on the larger size, to give an increased working range. There is a threaded hole in the body to take interchangeable shanks of different types.

MICROREX NO. 00 CENTRELESS GRINDER

Workpieces up to 1 in. diameter can be handled on the Microrex No. 00 centreless grinder built by Fabrications Mécaniques de Precision, Saint-Etienne (Loire), France (Stanley Howard, Ltd., 73 Devon Street, Saltley, Birmingham, 7). Shown in Fig. 9, the machine will take grinding wheels up to 12 in. diameter by 2⅜ in. wide, and the diameter of the control wheel is 7½ in. Mounted in water-cooled taper roller bearings, the grinding spindle runs at a speed of 2,000 r.p.m., and may be driven from a motor of 4 or 5 h.p. The spindle for the control wheel is mounted in taper roller bearings, and is driven by a ¼-h.p. motor, through a 2-speed gearbox which gives speeds of 25 and 280 r.p.m. Roller bearing guideways are provided for the control-wheel head and it can be tilted through a maximum of 6 deg. for through grinding operations, and swivelled to enable taper grinding to be carried out. There are separate hand-operated dressing attachments for the grinding and control wheels, and the slides which carry the diamond holders run on anti-friction guideways. Coolant is delivered through the diamond holder on the attachment for dressing the grinding wheel, and the other attachment can be adjusted for angle independently of the control-wheel head.

In-feed for a distance of ⅜ in. can be applied to the control-wheel slide by a lever, and settings for depth of cut are made by micrometer drum through a hardened and ground screw. In addition, feed can be applied in increments of 0·00004, 0·00008, and 0·00016 in. by pressing a push-button. Mounted on hardened steel guide pieces, the work rest can be fastened to the control wheel slide or the bed, and an attachment which incorporates two fixed guides and two adjustable guides

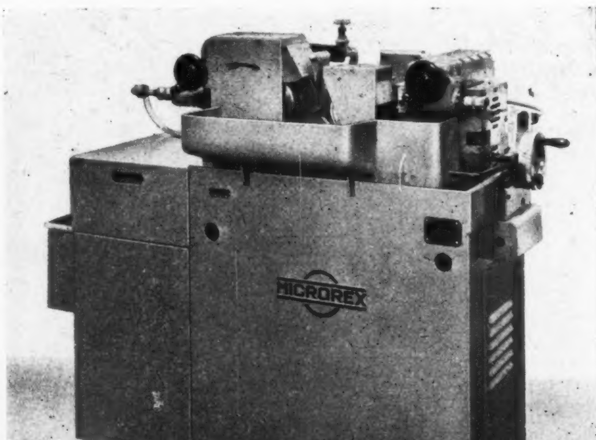


Fig. 9. French-built Microrex No. 00 centreless grinder

can be fitted to receive workpieces that have been ground by the through-feed method. A workpiece ejector can be supplied for attachment to the work rest when plunge grinding is to be carried out, and is automatically brought into use during the cycle by movement of the in-feed lever. A magnetic coolant separator is available.

KLINGELNBERG TYPE PFS 600 INVOLUTE AND HELIX ANGLE TESTING MACHINE

In Fig. 10 is shown the type PFS 600 involute and helix angle testing machine made by W. Ferd. Klingelnberg Sohne, Remscheid, Germany (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex). This machine will normally handle gears up to 23⅝ in. diameter, with modules from 0·75 to 20 mm. and helix angles from 0 to 90 deg., and also enables worms to be checked for lead angle. An additional work-slide attachment can be provided which permits gears up to 31½ in. diameter to be accommodated. Gears with a maximum face width of 6·29 times the cosine of the helix angle, and worms with lengths up to 6·29 times the sine of the lead angle can be checked on the machine. Mandrels, and gears with integral shafts up to 26 3/16 in. long can normally be admitted, but a special centre attachment can be provided which gives a length capacity of 33 in.

When the machine is in operation, the gear to be tested is turned by the rolling action between a disc mounted on the work spindle, and a straight-edge on a horizontal slide, which are held in contact with each other under a pre-set pressure. The same disc can be used for checking gears with base circle diameters which differ by a maximum of ±⅜ in. from the nominal value. When the gear is to be tested for helix angle, the slide which carries the measuring head is traversed in the vertical direction, and motion is simultaneously imparted to the horizontal slide by the "helix guide". In this way, the gear is turned, and the stylus pin on the measuring head is traversed across the face in contact with the flank of a tooth. The helix guide can be set to suit the helix angle of the gear to be tested with the aid of optical measuring equipment which gives readings to 1 sec. of arc.

The vertical and horizontal slides are mounted on ball-bearing guideways which ensure sensitive movements, and they can be traversed by hand, or automatically at steplessly-variable speeds. A mechanical-type recording unit can be provided which gives a magnification of 500 ×, and the ratio between the movement of the graph paper and the measuring slide can be varied from 1:1 to 8:1 in four steps. Alternatively, the machine

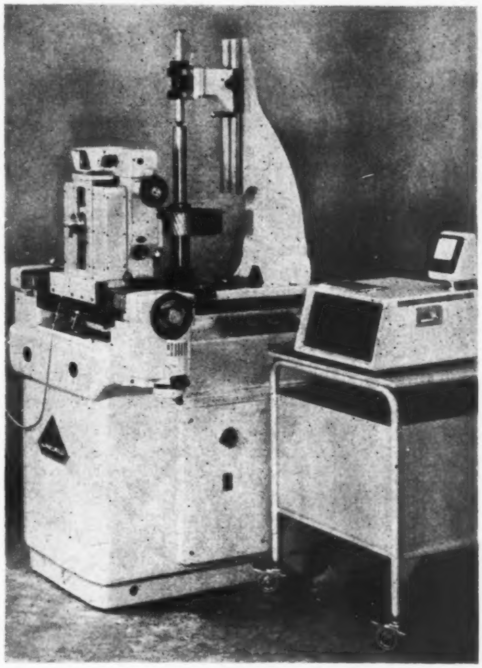


Fig. 10. The Klingelnberg type PFS 600 involute and helix angle measuring machine is here shown set up for use in conjunction with an electrically-operated recording unit

can be used in conjunction with an electrically-operated recording unit which is mounted on a separate wheeled trolley, as shown. Magnifications from 100 to 1,000 × are then obtainable, and the ratio between the traverse movement of the graph paper and the measuring slide can be varied in 6 steps. A high-sensitivity tracer head can be employed with the electric recording unit, which provides a magnification of 10,000 ×, and enables gear teeth to be checked for surface finish.

DÉRAGNE FINE BORING MACHINE

In Fig. 11 is shown the Diamanta 3 double-ended fine boring machine built by Ets. Déragne Frères, Villeurbanne (Rhone), France (Stanley Howard, Ltd., 73 Devon Street, Saltley, Birmingham, 7). This machine can be supplied with numbers of boring spindles from 2 to 8, and enables cuts to be taken on diameters up to 8 in. Drive to the boring heads mounted on each bridge may be taken from a single-speed or a 2-speed

motor, fitted with an electro-magnetic brake, and spindle speeds in the range from 250 to 4,000 r.p.m. can be obtained by means of interchangeable pulleys. Plain bearings or taper roller bearing, or special ball bearings for high-speed operation, can be provided for the spindles, and the boring heads can be mounted in various positions on the bridges to suit the work to be handled.

Measuring 13½- by 27⅜-in., the work-table has a maximum travel of 23⅜ in. on vee guideways, and adjustable feeds for rough and fine boring, also rapid power traverse, are provided hydraulically. The distance between the bridges is 31¼ in. A variety of automatic cycles can be obtained, which may provide, for instance, for taking a rough boring cut in the work with spindle heads mounted on one bridge, and a finishing cut in the same bores with the other heads. If required, workpieces may be loaded into a fixture mounted on the table while boring of other components is in progress. Rotary work-tables can be provided, also a transfer-type table, the cross movement of which may be imparted hydraulically or by compressed air.

A type 1H2 double-ended machine of similar design is available, which has a capacity for taking cuts in bores up to 5 in. diameter, and will accommodate a maximum of six spindle heads. Up to six spindle speeds in the range from 450 to 5,500 r.p.m. are obtainable by means of interchangeable pulleys. The distance between the bridges is 27⅜ in. and the 9⅜- by 22⅜-in. work-table has a maximum travel of 13½ in.

The company's range also includes Diamanta 1 and Diamanta 2 single-ended fine boring machines.

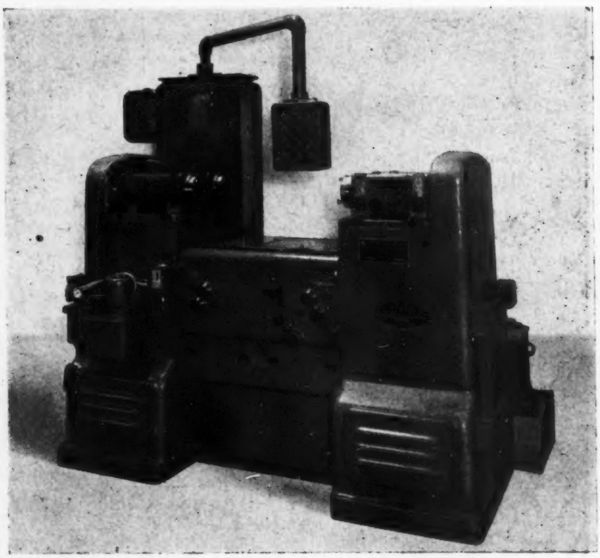
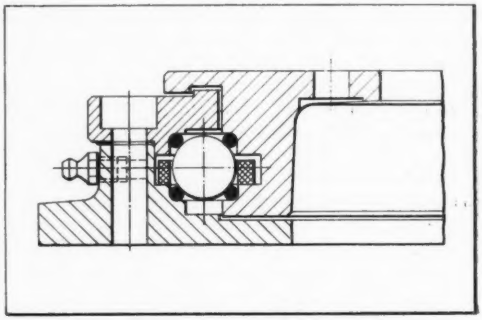


Fig. 11. Déragne Diamanta 3 double-ended fine boring machine

New Roballo Wire-race Ball Bearings

Roballo Engineering Co., Ltd., 43 Dover Street, London, W.1, have recently introduced a range of six new wire-race ball bearings, with diameters from



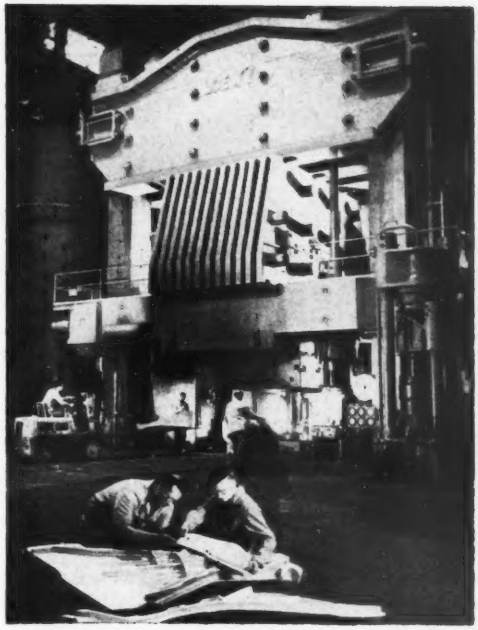
Sectional view of a typical Roballo wire-race ball bearing from a new range

18 to 40 in. (see also MACHINERY, 91/1435—20/12/57 and 96/192—27/1/60), which are intended for supporting indexing tables on machine tools and similar applications, and a sectional view of a typical unit is shown in the figure.

It is stated that, since the balls in each of these bearings are in contact in four places with the tracks on the spring steel wires, which are ground to suit the radius, high rigidity is obtained and accuracies of the order of 0·002 in. can be maintained for radial and axial run-out. The wires are inserted in accurately-machined grooves in medium carbon steel backing rings, which are flanged to enable them to be bolted directly to the associated machine members.

STILL CAMERAS to the total value of £121,000 were produced during the first quarter of this year.

Developments in the Forging of Materials for Service at High Temperatures



To meet the requirements for a variety of components for missiles and space vehicles, investigations have been carried out by the Wyman-Gordon Co., Worcester, Mass., U.S.A., in connection with the forging of metals and alloys which will retain the necessary degrees of strength at high service temperatures. Depending on requirements, parts for these applications are forged from three classes of materials: (1) the medium-high-temperature alloys, such as INCO 901, V57, and A286; (2) the nickel-base "superalloys," including Astroloy, Rene 41, and Waspaloy; and (3) the refractory metals—molybdenum, columbium, and possibly tantalum.

Parts of the medium-high-temperature alloys are being forged on a production basis for service in the 1,000- to 1,200-deg. F. range. When the service temperature exceeds 1,200 deg. F., but is below 1,800 deg. F., the nickel-base "superalloys" are applicable. For service at temperatures above 1,800 deg. F., the refractory metals must be employed. Experience in forging the refractory metals is, however, limited, and although there are some current applications, there are still many fundamental processing problems to be solved. Application temperature ranges for forgings of the various metals and an indication of the present situation as regards production are given in Fig. 1.

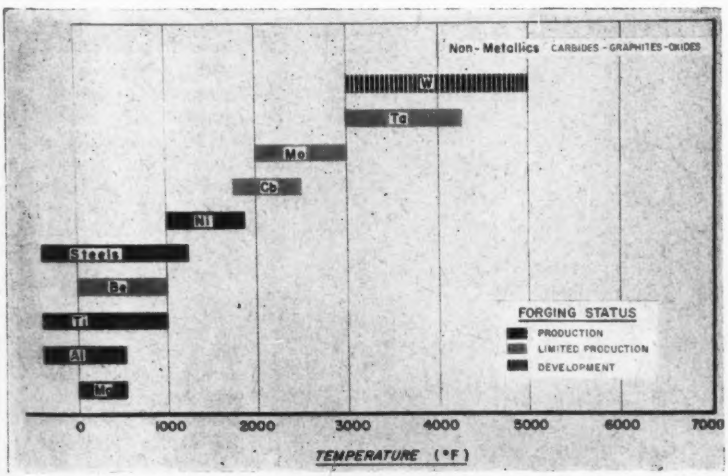


Fig. 1. Chart showing the service temperature ranges for forgings of various metals. The forging status of each metal is also indicated

Closed-die forgings of the iron- and nickel-base alloys for high service-temperature applications (above 1,000 deg. F.) are made with the workpieces heated to

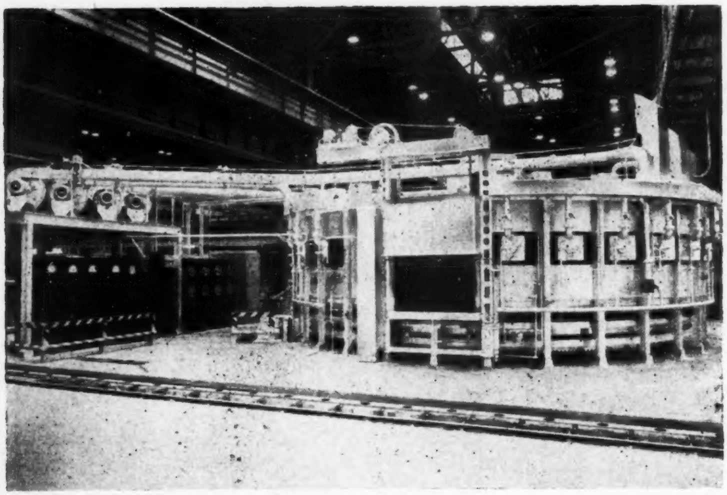


Fig. 2. Rotary-hearth furnace for heating stock for forging. Of 30 ft. diameter, it is equipped with instruments that maintain workpiece temperature within close limits

temperatures in the 1,600 to 2,100 deg. F. range. Furnaces used to heat the stock for forging at the company works are either of the conveyor type or of the rotary-hearth type shown in Fig. 2. Standard tool-steel dies, preheated to about 600 deg. F., are employed for these alloys as well as for the refractory metals. At these forging temperatures, parts made of iron- and nickel-base alloys are shaped (either on presses or hammers) and removed from the dies before the latter are damaged. In the heading illustration a part is being placed in closed dies in the 50,000-ton forging press at the Grafton, Mass., plant, owned by the United States Air Force and operated by the Wyman-Gordon Co. The press shown is one of two of this size which were constructed as part of the Air Force Heavy Press Programme.

Since the superalloys and refractories have greater strength at higher temperatures they are necessarily more difficult to forge, and the dies wear more rapidly. Die wear is greatest with the refractory metals, some of which are now being forged experimentally at temperatures in excess of 2,500 deg. F. Methods of improving dies are being studied, but the problem is not serious at present, since the number of forgings being produced from the refractory metals is insufficient to make die wear significant. Dies used for iron- and nickel-base alloy forgings do not normally show an amount of wear that could be regarded as excessive.

Contour machining of a closed forging die

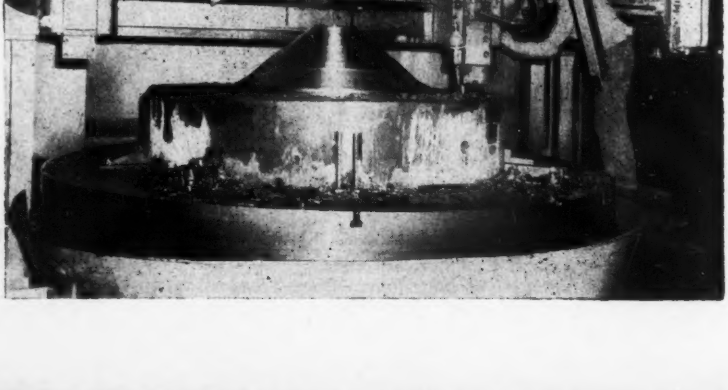


Fig. 3. Tracer-controlled contour machining is here seen in progress on a member for a closed-die for forging a missile nose cone. The completed die set was used on the press in the heading illustration

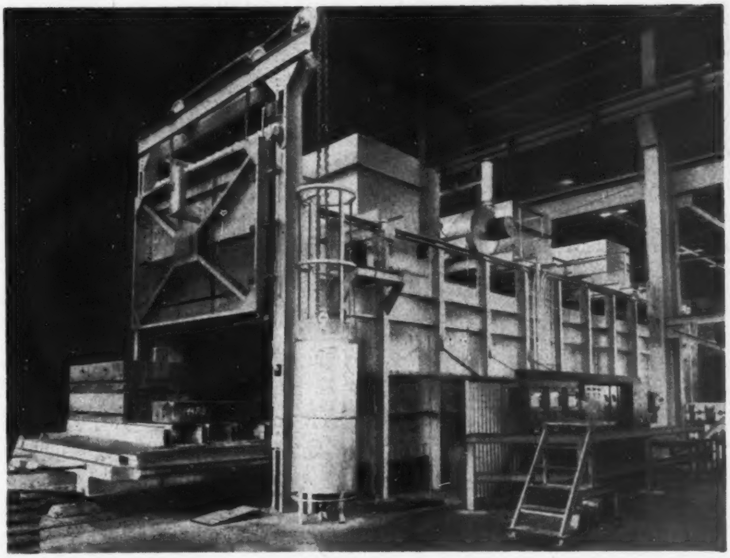


Fig. 4. Large closed-die blocks are pre-heated to temperatures up to about 600 deg. F. in this car type furnace

member on a vertical boring mill operated under tracer control is seen in progress in Fig. 3. When completed, the die set in which this member was incorporated weighed 70 tons and was used on the 50,000-ton press to forge nose cones for missiles. Die-blocks of this size are heated prior to use in a car type furnace, as shown in Fig. 4.

VARIOUS VACUUM-MELTING METHODS ARE USED

At present many of the parts which are being forged for high-temperature service are discs or wheels with cross sections of various contours. They are employed, for example, in jet aircraft as turbine wheels or compressor rotors. To enable satisfactory forgings to be obtained, careful control of processing must start with the melting of the metal. Most of these metals are melted in vacuum by one of several different methods and cast into ingots. For example, induction vacuum-melting techniques have been developed for the nickel-base super-alloys, whereas ingot of columbium are produced by vacuum consumable-electrode melting of electron-beam melted metal.

Since the nickel-base superalloys are extremely complex, they must be melted very carefully and then handled in such a manner as to avoid contamination before they are cast. In addition, they must generally be cast in special moulds, to minimize segregation of the various phases.

Fig. 5. Direct-reading spectrograph for analyzing the composition of forging materials. Reliable results are quickly obtained

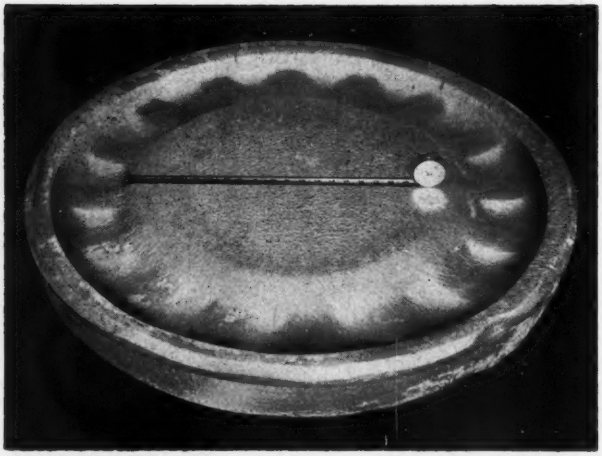


Fig. 6. This columbium part has been forged in closed blocking dies and is ready for the finishing operations

After they have been cast, ingots are cogged or bloomed, to reduce them to the required cross-section, and the material is then cut into billet lengths, for delivery to the forging plant.

Billets are generally inspected ultrasonically, and test pieces taken from various positions are etched and examined microscopically for phase segregation, exogenous inclusions, or other faults. Chemical composition, engineering properties, and forging characteristics are also determined. Samples from a billet, or a particular heat of material, are forged and tested to ensure that the metal can be properly worked before production is started. Then, during various stages of the production cycle, the material may again be ultrasonically inspected, etched, or checked with a dye penetrant to detect any defects which may have developed in the piece during forging. A direct-reading spectrograph (Fig. 5) is normally employed for determining chemical composition, since it is both rapid and dependable. If inclusions or discontinuities are present in a billet it is rejected, since the majority of discontinuities do not heal effectively during forging.

At this stage, engineers decide how much metal is required to forge a particular part, allowance being made for certain losses. A typical turbine-wheel forging may require a 300-lb. billet.

Initially, the heated billet is placed between flat dies and upset to a "pancake" shape. Subsequently, it is forged in closed dies. As many as four different closed dies may be required for a turbine wheel forging, depending on its complexity. When four closed dies are employed, the operation stages are normally termed pre-blocking, blocking, pre-finishing and finishing, each successive die serving to produce a more closely-defined contour.

Simple forgings do not require so many stages, and may often be processed directly in a finishing die. For most wheel contours, however, some blocking and a pre-finishing operation are needed. In Fig. 6, a workpiece of columbium alloyed with 1 per cent of zirconium is shown after it has been forged in closed blocking dies and is ready for the finishing operations.

Smaller turbine wheels are frequently forged on hammers which have sufficient power for such operations. For large-diameter wheels, however,

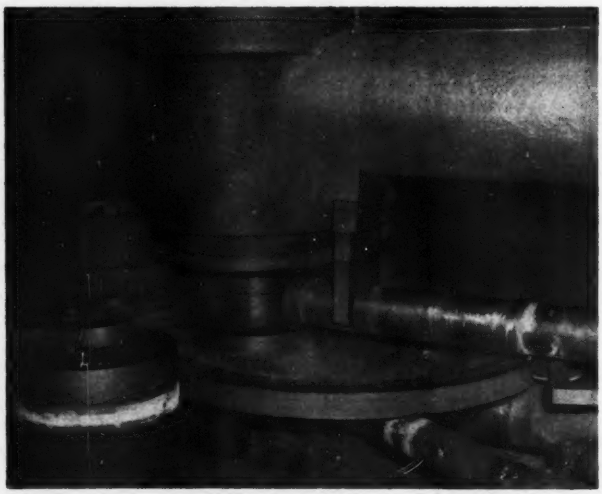


Fig. 7. A 40-in. diameter ring for a jet aircraft engine is here being roll-forged

Fig. 8. A turbine-shaft forging of a medium-high-temperature steel is here seen set up for the final operation in closed dies on 20,000-lb. hammer

heavy press equipment must be employed. The Wyman - Gordon Co. operate six closed-die forging presses with capacities ranging from 6,000 to 50,000 tons. In addition, forging operations are performed on special equipment such as the ring-rolling machine seen in Fig. 7. The rolls of this machine rotate the workpiece and exert pressure whereby it is shaped progressively. A 40-in. diameter ring for a jet aircraft engine is here being roll-forged.

A turbine-shaft forging of A-286 steel—one of the medium-high-temperature application alloys—is shown in Fig. 8 ready for the finishing operation in closed dies set up on a 20,000-lb. hammer. The part, which is cone-shaped, is 16½ in. long by 21 in. diameter at the large end, and weighs 233 lb.

When forging the nickel-base superalloys, temperatures must be carefully controlled within very narrow ranges. If a part is forged at a temperature either above or below the working range, it is liable to crack or break. With these materials, moreover, failure may occur at any time during a forging operation if there is even a slight defect which was not detected at the previous inspection. In general the superalloys and refractory metals, being difficult to work, are extremely sensitive to flaws and will fail during processing at an earlier stage than would materials with better forging characteristics.

Apart from the narrowness of the temperature range for forging, the amount and rate of deformation appear to be critical factors with some of the nickel base superalloys. These factors are not only related to the alloy but often also to the form of the workpiece. The development of improved mechanical properties depends both on the metallurgical composition and on the manner in which the parts

Fig. 9. This ring is one of two cut from a composite wheel-type forging of Rene 41, a nickel-base superalloy. On removal from the 50,000-ton press, the composite forging, of 44 in. diameter, weighed 712 lb.

Fig. 10. This refractory-metal forging has a " diameter " of 36 in., is 14 in. high, and weighs 1,300 lb. The material is columbium with 1 per cent zirconium

are worked. Final part structure, in other words, is determined largely by the manner in which the material has been deformed. The superalloys normally require more forging stages than the more easily worked metals.

Turbine wheels for certain propulsion systems are being forged from many of the nickel-base superalloys. In one instance, 50-in. diameter wheels made by the Wyman-Gordon Co. from Rene 41 have the following guaranteed minimum mechanical properties at 1,400 deg. F.: ultimate strength, 135,000 lb. per sq. in.; 0·2 per cent yield strength, 115,000 lb. per sq. in.; 0·02 per cent yield strength, 100,000 lb. per sq. in.; elongation on 2 in., 13 per cent; and reduction in area, 18 per cent.

One of two large rings which were machined from a 44-in. diameter, 712-lb., composite wheel type forging of Rene 41, made on the 50,000-ton press, is seen being checked in Fig. 9. Recently developments in connection with the forging of Astroloy have enabled wheel shapes up to 40 in. diameter to be produced within the minimum mechanical properties indicated in the accompanying table. Both Rene 41 and Astroloy were developed by the General Electric Co.

MECHANICAL PROPERTIES OF FORGINGS MADE FROM THE NICKEL-BASE SUPERALLOY ASTROLOY

	Room temperature	1,400 deg. F.
Ultimate strength, lb. per sq. in.	190,000	150,000
0·2 per cent yield strength, lb. per sq. in.	138,000	122,000
0·02 per cent yield strength, lb. per sq. in.	127,000	110,000
Elongation, per cent on 2 in.	8	10
Reduction in area, per cent	10	12

Fig. 11. Large closed-die aluminium forging for the Convair 600 4-engined jet aircraft. This bulkhead, which is 12 ft. long, weighs nearly 800 lb.

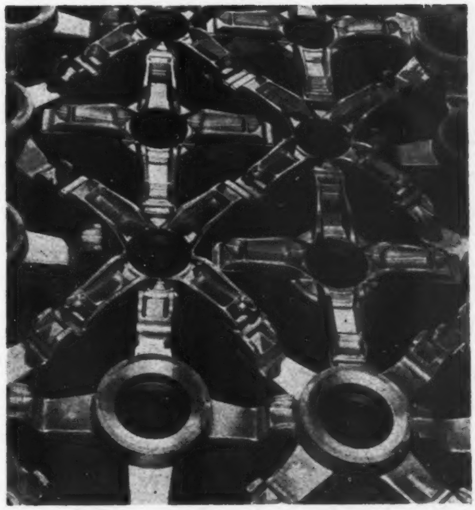


Fig. 12. Magnesium forgings for helicopters, each of which weighs 81 lb. and has a maximum dimension of 35 in. They were made in a closed-die on an 18,000 ton press

REFRACTORY METALS ARE COMING INTO USE

As was mentioned earlier, refractory metals must generally be employed when the forging is to be used at a temperature of 1,800 deg. F. and above. Nickel-base superalloy parts can sometimes be employed, where stresses are not severe, up to about 2,000 deg. F., but at higher temperatures only a refractory metal can be of any reasonable service. Molybdenum forgings are being made on a production basis for solid fuel rocket motors. Columbium forgings, containing 1 per cent of zirconium, and processed at 2,250 deg. F., have been made in sizes up to 36 in. diameter by 14 in. high, and weighing 1,300 lb. (Fig. 10). Tantalum, tantalum tungsten, and tungsten have also been forged on an experimental basis. Potential maximum application temperature for tungsten forgings is 5,000 deg. F.

Forging temperatures for the refractory metals are so much higher than those normally employed that special heating equipment and different handling techniques are necessary. Refractory-metal parts may be produced directly by powder metallurgy methods, the workpieces being machined from the compacts. Alternatively, forgings can be made either from compacts or from ingots cast from vacuum consumable - electrode melted material.

The refractory metals have one drawback in common, they lack oxidation resistance. In the case of molybdenum, oxidation causes deterioration of the metal, and columbium will crack due to gas diffusion along grain boundaries. Coating is the only method of protection that has so far offered prospects of success. Attempts have been made to alloy these metals, but with very little benefit as far as oxidation resistance is concerned. Although coating appears to offer a practical solution, coatings themselves present many problems. A test to determine the effectiveness of coatings on columbian forgings

Fig. 13. This die, for a magnesium helicopter forging, is set up fo machining under tape control

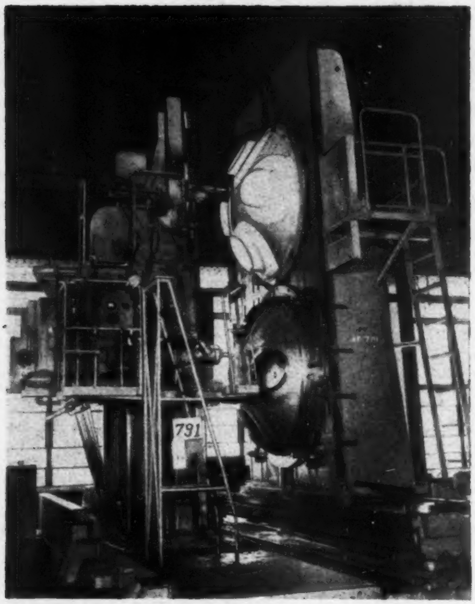


Fig. 14. A forged end closure for a rocket motor case is here being contour-milled on a Pratt & Whitney Keller die sinking machine

showed that oxygen-gas penetration (which causes cracking along grain boundaries) was reduced from 0·07 in. for uncoated to 0·05 in. for coated parts. The specimens were heated for two hours at 2,100 deg. F. for the test.

Graphite, the accepted lubricant for forging, has been the subject of much study. It has been found that coefficients of friction, when using graphite, can be greatly reduced by allowing oxygen to be absorbed along the interlaminar layers. Some recently compounded graphite type lubricants have additives that produce an atmosphere which assists interlaminar absorption of oxygen and thus reduces friction.

Beryllium—with its high modulus of elasticity, low density, reasonable heat resistance, and excellent strength-to-weight ratio—is destined to become an important metal for missile and space-vehicle construction. Since cast ingots of beryllium have limited workability, most parts are made from powdered beryllium either by press forging or by vacuum press sintering. Forged parts, on the average, have an ultimate strength of 53,000 lb. per sq. in., a 0·2 per cent yield strength of 40,000 lb. per sq. in., and an elongation of 2·4 per cent when tested at room temperature. Vacuum press-sintered beryllium has an ultimate strength of 40,000 lb. per sq. in., a 0·2 per cent yield strength of 30,000 lb. per sq. in., and an elongation of 1 per cent under the same conditions. At temperatures between 1,000 and 1,500 deg. F., however, forged and sintered beryllium have about the same properties. At present, forgings of beryllium up to 72 in. diameter can be produced.

Titanium, with its high strength-to-weight ratio, is also an important metal for missiles and aircraft. It is expected that with continued development it will be possible to produce closed-die forgings of B120VCA titanium alloy with yields strengths up to 200,000 lb. per sq. in. and an elongation of 5 per cent. End enclosures of 38 in. diameter have been forged for rocket motor cases. Titanium forgings have also been produced for such parts as pressure bottles for liquid rocket engines.

One of the advantages of the heavy presses is that large, complex, one-piece parts of the light metals, such as aluminium and magnesium, can be readily forged, the cost of joining many smaller members together being thus avoided. A large closed-die aluminium forging for a commercial aircraft is seen being placed in an ultrasonic inspection tank in Fig. 11. The forging is 12 ft. long and weighs approximately 800 lb. The closed-die forgings illustrated in Fig. 12 are 81-lb. magnesium components (35 in. across) for helicopters. They were made on the third largest forging press (18,000 tons) at the Grafton, Mass., plant.

Machining of dies, as well as of forged components, is receiving much attention. Die-sinking on an experimental basis is being performed under numerical control and by spark machining. A die is seen set up in Kearney & Trecker numerically-controlled machine for contour milling in Fig. 13. Chemical milling is also being employed for certain purposes. Typical of the more conventional operations carried out is the contour machining of a forged closure for a rocket motor case on a Pratt & Whitney Keller die-sinking machine, as seen in Fig. 14.

Polythene-coated Paper Sachets. Special plant has been installed by Stonehouse Paper & Bag Mills, Ltd., Lower Mills, Stonehouse, Gloucestershire, for the manufacture of polythene-coated sachets in a variety of different papers and overall sizes.

These sachets are particularly intended for packing articles that would be affected by damp, also items to which oil or grease must be applied for protection against corrosion, such as instruments, tools, and engineering components. After they have been filled, the containers can be heat-sealed.

NEWS OF THE INDUSTRY

Yorkshire

Anderton Springs, Ltd., Clyde Street, Bingley, inform us that there has been a steadily growing demand for their range of standardized circlips from both the home and export markets during the past year, and that trade has increased to such an extent that a considerable works expansion programme has been undertaken. An addition to the Clyde Street premises, which provides a 50 per cent increase in capacity, has recently been completed and this new section is now in full production. A new plating plant, which will afford improved facilities for electrodeposition of nickel, cadmium, zinc, and tin, is shortly to be installed. A heavy auto-ring coiling machine for handling materials up to 0·200 in. diameter has been purchased, and other specialized machinery which is shortly to be added to the plant will include 4-slide automatic forming machine for producing spring pressings. In addition, a number of heavy type presses is on order to meet the requirements of the 1962 expansion programme.

A new design of circlip pliers has been developed and it is hoped to start production shortly. We are informed that a new catalogue containing 35 pages of data sheets and information on the company's range of products has recently been issued, copies of which are available on request.

The Dee-Kay Engineering Co., Ltd., Victoria Works, Bingley, makers of jigs, fixtures, press tools, and dies, report that their new toolroom has now been completed, and is in full operation, the plant having been installed during the recent holiday period. A fully air-conditioned room is being prepared to house the precision equipment used by the company, including jig borers, jig grinders, and optical profile grinders.

To answer the increasing calls on the services offered by the company, it is planned to install a number of additional toolroom machines and other units next year, apart from normal replacements.

Individual Tools, Ltd., Seven Dial Works, Church Street, Bingley, report that their works are maintaining a steady output of various types of press tools and special sheet metal working machinery. A number of internal flanging machines has recently been despatched for use in the domestic appliance manufacturing industry.

Ellison Spring Clips, Ltd., Harden, near Bingley, inform us that their new factory is now in full operation and that production has been substantially increased. Owing to the heavy demand from both the home and export markets, however, additional plant is being provided to enable output to be further expanded. Equipment recently installed has included a 500-ton capacity press.

Keighley Grinders (Machine Tools), Ltd., Aireworth Works, Aireworth Road, Bradford Road,

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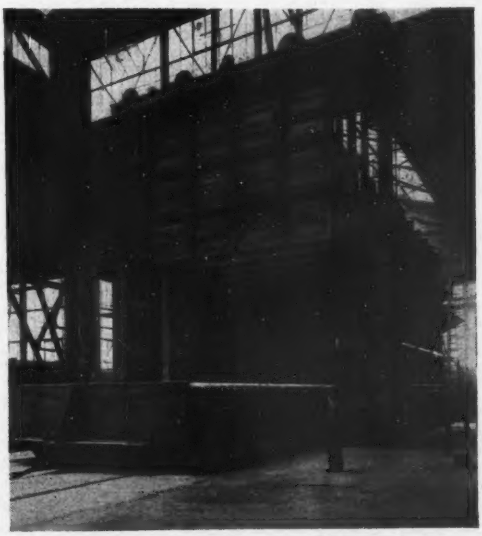
Installed at the Victoria Works of Harland & Wolff, Ltd., Queens Island, Belfast, this large furnace is employed for stress-relieving operations on weld-fabricated bed plates and scavenge belts for marine diesel engines, for example. Supplied by Priest Furnaces, Ltd., Middlesborough, the furnace will accept a workpiece measuring 32 ft. long by 19 ft. wide by 13 ft. high, and the wheeled bogie seen in the foreground, whereby it is loaded, has a carrying capacity of 70 tons



Keighley, report a sustained demand for their range of precision grinding machines. We are informed that approximately 40 per cent of output is for export, and that orders are in hand from Poland, France, Germany, Canada, India, and Australia. This company recently showed products in Moscow and Poland, and we may note that a number of machines is also to be displayed at a forthcoming exhibition in Yugoslavia.

It is stated that the hydraulic system on the K.L.G.G. gauge grinding machine has recently been modified with outstanding results. The numerous machines seen in the course of production in the works included a number of crank-pin grinders, and a universal grinder with a capacity of 18 in. diameter by 72 in. long. A new fitting and assembly bay with an area of some 5,000 sq. ft. is at present nearing completion.

LANDIS LUND, LTD., Eastburn Works, Cross Hills, inform us that the volume of orders and enquiries for their precision grinding and fine boring machines is being maintained at a high level, and that export orders are at present in hand for Argentine, Brazil, Russia, Israel, India, Italy, Poland, Spain, South Africa, France, and Switzerland. Four machines were shown at the 7th European Machine Tool Exhibition in Brussels, and comprised a Landis Lund Gardner 2H30-30-in. double-spindle disc grinder equipped for finishing the side faces of bearing races; a Landis Lund Precimax Type FB 2 fine borer, tooled for boring, facing and chamfering operations on motor vehicle differential housings; a Landis Lund 16-in. Type DH crankpin grinder arranged for operations on crankshafts for six-cylinder motor car engines; and a Landis Lund 5-in. Type DH cam contour grinder which was shown set up for finishing the cam profiles on a camshaft for a four-cylinder engine. In addition to the above, a wheel-head for a grinding machine, equipped with the Landis profile dresser with a rotary diamond tool, was exhibited, and will be described in a subsequent issue of MACHINERY.

Other machines at present in production include a type MPB 12 by 24 plain grinder with a hydraulically-operated profile dressing attachment for the wheel, and two type R plunger grinders, each with an angular wheel-head mounted on a base of fabricated construction. Each of these machines will be provided with work loading and cycle control equipment.

R. SUTCLIFFE.

National Engineering Laboratory

Details of the work that is being undertaken and the progress that is being made by the National Engineering Laboratory, East Kilbride, Scotland, are given in the Annual Report* for 1960, which is now available. Since the D.S.I.R. established the N.E.L., a new programme of Government sponsored research has been directed towards helping the engineering industries to improve their products and processes, and the N.E.L. can now claim to be one of the leading centres for engineering research in this country. During the early years of its existence, great efforts were made to provide the laboratory with extensive research facilities, to develop novel research rigs and measuring techniques, and to build up an experienced staff of scientists and engineers. From the outset, the laboratory was engaged in both basic and applied research, and the policy pursued is now bearing fruit.

In the report, attention is drawn to three particularly successful projects—the automatic correction of errors in machine tools, the development of hydrostatic power transmissions, and the cold extrusion of steel. In two instances, there has been an encouraging response from industry.

In the machine tool field, David Brown Industries, Ltd., have collaborated with N.E.L. in applying moiré-fringe techniques to the automatic correction of errors in the table drive of a standard gear hobbing machine. There are many other potential applications of this system, and the further collaboration of industry would be welcomed.

The machine tool industry has also shown considerable interest in the N.E.L. hydrostatic power transmission applied to a vertical boring machine. Another hydrostatic transmission system developed by the Laboratory is being manufactured, under licence by several British firms, and two companies in the U.S.A. have applied for manufacturing rights. In addition to applications to machine tools and motor vehicles, these transmission systems are of considerable significance in many fields, including marine propulsion, crane haulage, coal cutting and earth moving.

The Laboratory is now assisting industry in the design of tooling for relatively simple cold-extruded products, and further work on more complicated

* National Engineering Laboratory Annual Report, 1960; H.M ationery Office; Price 5s. 0d.

shapes is in progress. Few British firms have introduced this process, although considerable interest has been shown abroad, and it is urged that British industry should sponsor design studies, to be confirmed by experiment, for the production of particular components.

Work has been undertaken relating to the fatigue of metals at high temperatures, and is particularly important in relation to aircraft gas turbines, which operate under fluctuating stresses at high temperatures. Current investigations are concerned, for example, with the high-temperature fatigue properties of brazed joints, such as are used in one of the methods of attaching rotor blades. Work is also being carried out to provide information on the fatigue strength of hollow blades produced by different methods.

A substantial part of the Laboratory's efforts is directed to background research, and although the results may not be of direct or immediate interest, the application of such work may be of importance in the future. One of the most important developments in this field is the production of new materials, using very high pressures and temperatures. The N.E.L. has proved its equipment by making artificial diamonds from graphite, and further studies are being pursued in connection with the nickel-carbon system at high pressures. Later stages of this work are likely to be of great significance for industry, since the Laboratory may not only be able to produce new materials, without natural counterparts, but may also be able to synthesize materials with particular combination of desirable properties.

The Laboratory has determined the relative rate of crack growth for a wide range of engineering materials. This work is aimed to provide a fundamental explanation of fatigue damage and failure, and to define the qualities required to resist such damage.

Tests have been carried out in connection with the lubrication of hypoid gears, using extreme-pressure lubricants, at running speeds equivalent to road speeds of 60 m.p.h., and at temperatures up to 100 deg. C. Results have confirmed conventional theory, but hydrodynamic conditions (complete-film lubrication) were found to exist more frequently than was expected. The main action of e.p. lubricants appears to be to provide surface protection when there is no hydrodynamic lubrication—for example, when starting and stopping—and in general, to maintain a surface conducive to hydrodynamic lubrication.

Measurement provides the basis of the Laboratory's researches, and it is often necessary to develop new instruments and techniques to obtain the required accuracy. Many of these developments will find application in other laboratories and some are also applicable to industry. They range from portable equipment for measuring the flow of water in penstocks of hydro-electric power stations, to instruments for measuring the air content in oil samples from oil-hydraulic circuits and digital methods of measuring shaft speed, temperature and pressure. A technique for measuring the wear in diesel engine cylinder liners has also been developed, which is safe and easy to apply.

One of the most important services offered by the N.E.L. to industry is the provision of facilities for sponsored research. This service is being used with increasing frequency, and the work includes long-term basic investigations, design studies, development projects and the calibration of instruments. The N.E.L. has unique facilities to offer, and is particularly interested in proposals for novel investigations that are likely to lead to important new developments. Assistance can be provided in many ways—from accepting the full burden of the work to be undertaken, to supervising or assisting a firm's own engineers and scientists. Charges depend on the duration and complexity of the work, and in some instances it is possible to make the results completely confidential to the sponsor.

The Advantages of Vibratory Finishing

(Continued from page 651)

of 30 min. In another instance, camshafts are being treated for removal of burrs and improvement of surface finish. The fixture employed holds 39 shafts, and the cycle time is only 12 min.

Apart from machined parts of both ferrous and non-ferrous metals, the vibratory process is being employed for operations on castings, forgings, and pressings, and it seems evident that it represents a valuable addition to available finishing methods.

Books Received

KINEMATICS AND DYNAMICS OF MACHINERY. By R. L. Maxwell. Prentice-Hall International Inc., 28 Welbeck Street, London, W.1. 477 pp. [Price 45s. net.]

The author has covered those parts of applied Newtonian mechanics which are essential to engineers. His treatment is both graphical and analytical, and an attempt has been made to relate mathematical theory to mechanical practice. Conventional notation has not always been followed, but deviations—mainly for visual convenience—have been fully explained. The 23 chapters cover displacement, velocity and acceleration, kinetic analysis, the dynamics of particles and rigid bodies, work, energy and impulse; also—with reference to mechanisms and functional pairs—such matters as critical speeds, balancing, gyroscopic effects, cams, gearing, flywheels, and governors.

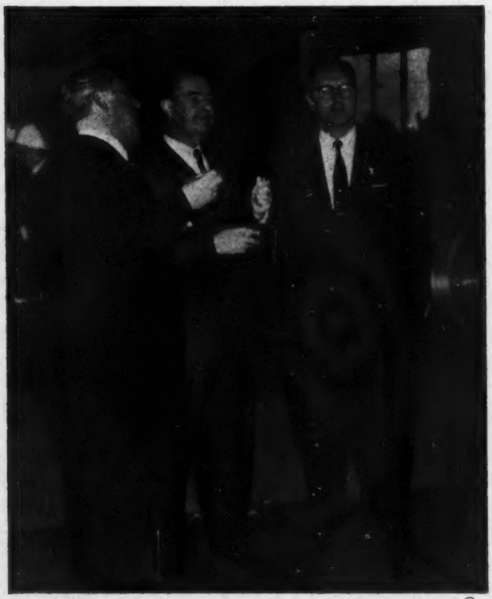
Visit of the British Ambassador to the 7th European Machine Tool Exhibition, Brussels

DURING THE COURSE OF THE 7th European Machine Tool Exhibition, Brussels, which closed on September 12, a tour of a number of the stands of British exhibitors was made by the British Ambassador, Sir John Nicholson, K.C.M.G. His Excellency visited as many stands as possible in the time at his disposal, and the remainder were called upon by the Counsellor-Commercial. During his tour, of which some photographs are shown on this, and the following page, His Excellency was accompanied by Mr. Robert W. Asquith, chairman of Asquith Machine Tool Corporation, Ltd., and the first British President of the European Committee for the Co-operation of Machine Tool Industries.

In his Presidential address, at the official opening of the Exhibition, Mr. Asquith expressed the hope that "our user friends would take this further opportunity of discussing the improved production facilities displayed," and that such discussions, supported by the technical demonstrations, would persuade them "that there really is something to be said for plant replacement." Most users, he continued, always seemed to have had two main lines of thought—namely, that in good times the machine tool industry reputedly could not meet demands, because of the length of its order books, and in bad times that users could not justify replacement of machines and equipment.

Continuing, Mr. Asquith said that such an outlook was unsatisfactory and that in good times the additional productivity which the newer machines could provide was greatly needed. He suggested that the users of machine tools could improve deliveries by "starting forward planning at an earlier date," and that "bad times are the best in

(*Continued on page* 700)



(Left to right) Mr. Robert W. Asquith, His Excellency the British Ambassador, Sir John Nicholson, K.C.M.G., and Mr. W. G. Hunt (William Asquith, Ltd.)

(Left to right) Mr. R. Beechey and Mr. K. G. Walton (Brooke Tool Automation, Ltd.), His Excellency, and Mr. H. S. Holden (Brooke Tool Automation, Ltd.)

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(Left to right) His Excellency and Mr. T. N. Woof, M.C. (B.S.A. Tools, Ltd.)

(Left to right) Mr. E. W. Field, O.B.E. (H. W. Ward & Co., Ltd.) and His Excellency

(Left to right) His Excellency and Mr. B. C. Harrison (Alfred Herbert, Ltd.)

(Left to right) His Excellency and Mr. H. Wilkins (Wilkins & Mitchell, Ltd.)

(*Continued from page* 698)
which to undertake shop evaluation and improvement."

The President had earlier drawn attention to the co-operation which had been achieved between the European and United Kingdom industries, and expressed the hope that this pattern might be followed "by those whose work lies in a higher—or at least a different—plane, namely that of political activity." "There can be no doubt," he continued, "that there is no strength in a divided house, and since strength—and productive strength—is the real need in Western Europe to-day, there can be but one answer to the problem which the European Community is overcoming, and which has caused my own country so much heart searching."

Industrial Notes

BLACK & DECKER, LTD., Harmondsworth, Middlesex, have acquired the Italian firm of Star, manufacturers of portable electric power tools. Located at Civate, near Lake Como, the Star plant has an area of 86,000 sq. ft. The company produces a range of double-insulated tools, including single- and 2-speed drills, tappers, screwdrivers, sanders and grinders.

EMPLOYMENT IN THE MANUFACTURING INDUSTRIES.—The number of persons employed in July was little changed. There was a rise of 1,000 in "engineering and electrical goods" and for "shipbuilding and marine engineering" the total was unchanged. In "metal manufacture" the total fell by 2,000, and in "vehicles" and "metal goods" by 1,000.

THE GAUGE AND TOOL MAKERS' ASSOCIATION, Standbrook House, 2-5 Old Bond Street, London, W.1, will hold their next Trade Luncheon on October 3 at the Savoy Hotel, London. The Guest of Honour will be the Rt. Hon. Edward Heath, M.B.E., M.P., the Lord Privy Seal, and the subject of his address will be the European Common Market.

"ALL IN A DAY'S WORK" is the title of the latest 16-mm. sound film to be released by Brook Motors, Ltd., Empress Works, Huddersfield. The film, made by the firm's production unit, is in colour and runs for 17 min. It shows many interesting manufacturing sequences in the large-quantity production of large and small electric motors, and is available on loan, free of charge.

FERRANTI, LTD., Hollinwood, Lancs., are to build four 570 MVA, 3-phase, 22/430 kV delta star connected, 50 cycles per sec. double-wound generator transformers, for the Central Electricity Board. These units, which will be installed at the coal-fired power station at West Burton, Notts., will connect four 500 MW turbo-generators to the Supergrid. Claimed to be the largest generator transformers yet built, they will cost more than £1 million.

FRASER & BORTHWICK, LTD., Pitt Street, Glasgow, makers of sheet metal and plastics components, and electrical control panels have established a new factory at Galston, Ayreshire, with a floor area of 40,000 sq. ft. The new plant is intended to operate in conjunction with the new Colvilles steel strip mill and motor car works in Scotland. A labour force of 100 is expected to be in operation by the end of the year.

THE PLESSEY CO., LTD., Ilford, Essex, inform us that they have now acquired the share capital of the SPE Co., Ltd., Slough, Bucks., from the Booker Group. The SPE Co., Ltd., manufacture a range of aircraft fuel pumps and associated equipment which is complementary to the range made by the Aircraft Mechanical Division of the Plessey Co., and will continue to operate as an autonomous company within the Plessey Group.

MATCHLESS MACHINES, LTD., inform us that they have transferred their offices, stores and demonstration rooms to Matchless Works, Crawley Road, Horsham, Sussex (telephone Horsham 60271; telegraphic address, Matchless Telex Horsham; Telex No. 8798). Greatly improved showrooms are available at the new address, and the company will be able to demonstrate a far wider range of machines and equipment, under conditions as near to "normal working" as possible.

STANDARD FOR INTERNAL COMBUSTION ENGINES.—A revised British Standard (B.S. 765: 1961) has been issued for internal combustion engines of the spark ignition type. When the specification was first issued, in 1938, it was confined to carburetter type engines. In view of the fact that the carburetter is now sometimes replaced by fuel injection, the title and scope of the Standard have been changed. Copies can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1 (Price 6s.—postage extra to non-subscribers).

LAPOINTE MACHINE TOOL CO., LTD., Otterspool, Watford By-Pass, Watford Herts., has now completed extensions, which will add 10,000 sq. ft. to the total factory area. The extensions have been made necessary by increasing commitments in the United Kingdom and the steady expansion of export business, but provision has also been made for future growth. The extra space has permitted the expansion of storage facilities, the provision of a larger and improved re-grind section, a new apprentices training division, and a two-fold increase in the size of the electrical assembly department and machine assembly bays.

Post-graduate Courses in Nottingham

A number of special post-graduate courses have been arranged for the Autumn term by the Nottingham and District Technical College, Burton Street, Nottingham. The subjects covered are as follows:—Pumps and compressors; electronics for mechanical engineers; applied elasticity; the statistical control of quality in engineering production, and advanced engineering metrology. The lectures will be held from 6.45 to 9.0 p.m. on Mondays to Fridays respectively, and the first lecture of each course will be in the week commencing September 25. Full details and enrolment forms can be obtained from the Registrar at the college.

Personal

Mr. Gerard Young, J.P., chairman of Tempered Group, Ltd., has been elected the 326th Master Cutler.

The following new appointments have been announced:—

Mr. C. R. Meyer, previously assistant managing director, to be managing director of Cincinnati Milling Machines, Ltd., Kingsbury Road, Birmingham, 24, on the resignation of Mr. J. A. Beebe, who is returning to the U.S.A.

Mr. Robert Butler, formerly a director of Quasi-Arc Ltd., as managing director of Eutectic Welding Alloys Co., Ltd., North Feltham Trading Estate, Faggs Road, Feltham, Middlesex.

Mr. D. F. Kemp as technical representative of Headland Gauges, Ltd., 45-46 Lower Marsh, London, S.E.1, with responsibility for Berkshire, Buckinghamshire, Bedfordshire, Essex, Hertfordshire, Northamptonshire, Norfolk, Suffolk and the North London postal area.

Mr. T. H. R. Perkins, marketing director, as assistant managing director, Mr. D. F. W. McNair as deputy director of marketing, Mr. J. M. Collins, a director of Perkins Engines, Ltd. as general manager of the sales division and Mr. H. Lymath as group project co-ordinator, of the Perkins Group, Peterborough.

Scrap Metals

Midlands.—In general, there has been no improvement in the demand for steel scrap from local steelworks, and with consumers in other parts of the country in much the same position, it is difficult for merchants to clear even their normal intake of heavy loose scrap, and bales. Local works are on rigid allocations for heavy steel scrap to specifications No. 1 and 2, and, consequently, merchants have reduced their prices for material which has to be held in stock.

Buyers of short heavy steel scrap are also keeping their acceptances to a minimum, and, at the same time, reducing their prices by about 10s. per ton. Both steel turnings and destructor bales are hard to place, as the allocations given by the blast furnaces only cover part of the output from Midlands factories and yards.

The demand for cast iron scrap continues to be keen. Where reasonable tonnages of light cast scrap can be offered, foundries are prepared to pay increased prices to ensure continuity of deliveries. During the past few weeks, the movement of machinery cast has caused an improvement of several shillings per ton in the prices for oversize cast scrap for breaking and merchants are fully occupied in dismantling plant units to provide more cast iron scrap of this type.

Light pressing scrap can be delivered by road, in particular light steel and light iron grades, but markets for No. 4 bales are limited and markets for No. 5 bales are almost entirely closed. Nickel steel scrap can be placed, prices being based on the nickel content, but there has been an easing in prices paid for stainless steel scrap.

Indications are that the present limited trading conditions will continue.

BRITISH MACHINE TOOL

Exports of New Machine Tools

Countries	Bar and Chucking Automatics		Vertical Boring Machines		Other Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Capstan and Turret Lathes		Other Lathes	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Commonwealth																
South Africa	—	—	6 (2)	354	231 (3)	8,072	252 (95)	6,787	—	—	220 (91)	12,509	196 (4)	8,088	438 (17)	11,639
India	241 (2)	13,394	1,288 (4)	66,945	176 (18)	8,730	370 (13)	27,472	—	—	874 (35)	39,054	697 (15)	32,923	1,559 (17)	95,719
Pakistan	25 (1)	3,115	2 (1)	65	11 (3)	737	153 (3)	3,814	—	—	95 (19)	4,072	—	—	—	—
Australia	31 (1)	4,449	—	—	746 (6)	23,063	763 (33)	19,450	59 (3)	4,067	510 (20)	22,476	817 (19)	34,814	2,057 (55)	96,737
New Zealand	—	—	—	—	—	—	194 (12)	4,991	—	—	51 (6)	1,528	109 (4)	4,678	604 (20)	26,481
Canada	—	—	—	—	—	—	161 (6)	2,741	—	—	305 (69)	11,795	31 (1)	1,696	946 (35)	35,927
Miscellaneous	—	—	7 (3)	744	24 (3)	603	332 (82)	9,286	—	—	331 (82)	8,230	365 (6)	18,361	921 (57)	31,066
Foreign																
Soviet Union	200 (2)	16,362	—	—	—	—	—	—	313 (3)	15,158	1,600 (6)	56,531	—	—	293 (1)	17,088
Sweden	—	—	—	—	— (1)	76	69 (3)	2,312	—	—	153 (5)	5,056	745 (17)	38,011	209 (3)	11,098
Norway	—	—	—	—	—	—	162 (2)	3,070	38 (1)	3,996	—	—	—	—	82 (6)	3,076
Denmark	—	—	—	—	—	—	35 (4)	1,508	—	—	—	—	65 (2)	3,772	25 (2)	1,283
Western Germany	—	—	33 (1)	1,028	140 (3)	12,713	1 (2)	136	—	—	229 (5)	19,637	140 (3)	6,699	541 (35)	21,865
Netherlands	—	—	—	—	2 (1)	314	115 (6)	3,240	—	—	77 (3)	4,964	236 (8)	14,802	17 (2)	714
Belgium	—	—	—	—	6 (9)	265	36 (4)	1,349	—	—	115 (5)	3,894	283 (6)	7,597	—	—
France	39 (1)	2,199	159 (1)	4,337	8 (1)	175	—	—	—	—	234 (6)	11,655	248 (5)	12,356	274 (4)	12,187
Switzerland	—	—	—	—	—	—	36 (3)	1,538	—	—	110 (5)	8,046	219 (6)	14,662	259 (24)	12,262
Spain	—	—	—	—	—	—	—	—	—	—	440 (5)	25,151	—	—	—	—
Italy	363 (2)	23,263	—	—	—	—	16 (1)	519	165 (4)	4,766	395 (21)	18,758	525 (5)	30,360	655 (3)	46,801
U.S. America	—	—	—	—	—	—	74 (8)	1,678	—	—	117 (9)	7,690	99 (7)	5,181	516 (25)	18,205
Miscellaneous	40 (1)	5,122	292 (3)	8,367	351 (9)	25,700	344 (79)	10,134	132 (3)	7,560	951 (134)	48,894	513 (15)	27,077	1,357 (75)	60,156
Total	939 (10)	67,904	1,787 (15)	81,850	1,695 (57)	80,448	3,113 (356)	100,025	707 (14)	35,547	6,807 (526)	309,940	5,288 (123)	261,077	10,753 (381)	502,304

Total exports of reconditioned machine tools: Quantity: No., 212; Weight, 17,449 cwt.; Value, £88,806.
Total exports of imported machine tools: Quantity: Weight, 1,274 cwt.; Value, £44,216.

Imports of New Machine Tools

Country of Origin	Bar and Chucking Automatics		Vertical Boring Machines		Other Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Capstan and Turret Lathes		Other Lathes	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Sweden	—	—	—	—	10 (1)	1,121	199 (27)	4,449	—	—	795 (22)	53,417	—	—	32 (3)	755
Western Germany	57 (3)	6,504	587 (8)	28,622	457 (11)	27,808	248 (26)	11,420	143 (4)	12,033	2,097 (42)	140,102	359 (11)	32,303	1,159 (50)	65,612
France	—	—	—	—	—	—	—	—	—	—	—	—	10 (1)	487	61 (2)	4,006
Switzerland	362 (22)	38,577	548 (3)	41,074	—	—	44 (5)	2,671	75 (7)	9,157	340 (59)	37,342	308 (7)	30,142	480 (15)	39,527
U.S. America	289 (3)	15,436	14 (2)	1,300	142 (3)	16,933	363 (14)	32,514	1,047 (14)	93,567	3,304 (48)	250,360	—	—	591 (9)	34,611
Miscellaneous	—	—	81 (2)	4,261	1,624 (3)	99,912	140 (4)	2,581	532 (5)	25,168	366 (22)	15,049	133 (3)	2,173	993 (12)	33,049
Total	708 (28)	60,517	1,230 (15)	75,257	2,233 (18)	145,774	994 (76)	53,635	1,797 (30)	139,925	6,902 (193)	496,270	810 (22)	65,105	3,316 (91)	177,560

Total imports of reconditioned machine tools:—Quantity: No. 134; Weight, 1,975 cwt.; Value, £72,875.

IMPORTS AND EXPORTS (Classified)

and Parts during April, 1961

Milling Machines		Presses		Sheet-metal Working Machines		Sawing Machines		Screwing and Threading Machines		Planing, Shaping and Slotting Machines		Unit Transfer Machines and Heads		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
152 (6)	8,257	1,657 (18)	30,855	551 (10)	8,150	35 (4)	746	28 (1)	811	42 (3)	1,041	66 (6)	3,522	913 (52)	25,550	257	12,718	5,044 (312)	139,109
569 (10)	32,370	439 (5)	10,912	598 (6)	17,090	268 (4)	21,054	—	—	372 (6)	12,768	—	—	251 (25)	13,839	1,467	80,017	9,169 (160)	472,287
189 (2)	9,687	—	—	164 (2)	4,760	23 (1)	1,194	—	—	108 (1)	2,756	—	—	7 (4)	581	131	2,433	908 (37)	33,214
730 (24)	32,409	568 (6)	18,489	77 (40)	1,972	—	—	285 (9)	18,545	143 (13)	4,691	—	—	13 (3)	1,149	1,077	51,360	7,876 (232)	333,671
192 (5)	7,362	277 (8)	4,222	20 (2)	824	11 (2)	413	—	—	65 (4)	2,043	—	—	110 (14)	3,283	40	3,939	1,673 (77)	59,764
423 (7)	21,389	—	—	127 (1)	2,152	3 (2)	146	31 (1)	2,902	51 (5)	1,161	—	—	225 (4)	5,143	101	8,162	2,404 (131)	93,214
102 (4)	4,629	6 (7)	138	299 (25)	8,021	51 (7)	1,581	25 (4)	850	64 (5)	1,470	—	—	72 (28)	3,606	348	19,025	2,947 (313)	107,610
—	—	—	—	94 (2)	13,463	—	—	450 (3)	22,601	—	—	—	—	537 (1)	16,200	—	—	3,487 (18)	157,403
481 (4)	21,696	—	—	—	—	15 (7)	1,475	—	—	15 (1)	900	—	—	371 (4)	15,618	99	8,244	2,157 (45)	104,486
—	—	210 (2)	3,718	— (1)	11	—	—	—	—	29 (1)	549	—	—	6 (1)	307	14	1,802	541 (14)	16,529
125 (2)	6,081	—	—	—	—	—	—	7 (1)	368	—	—	—	—	138 (2)	6,333	20	2,194	415 (13)	21,539
188 (2)	12,303	169 (2)	8,911	60 (1)	2,250	—	—	63 (2)	5,639	—	—	—	—	189 (3)	7,477	272	24,151	2,025 (59)	122,809
365 (6)	14,493	107 (1)	5,501	11 (6)	550	42 (4)	734	105 (4)	7,531	—	—	—	—	566 (6)	33,992	238	20,880	1,881 (47)	107,715
—	—	—	—	260 (2)	9,223	84 (1)	1,652	—	—	27 (10)	754	—	—	6 (6)	330	84	3,910	901 (43)	28,974
140 (1)	4,855	510 (44)	13,458	57 (1)	6,020	136 (1)	2,522	85 (1)	5,823	—	—	—	—	30 (2)	929	414	30,639	2,334 (68)	107,155
705 (8)	30,149	31 (1)	2,475	—	—	—	—	—	—	—	—	—	—	35 (1)	1,375	25	2,869	1,420 (48)	73,376
—	—	170 (1)	6,952	—	—	—	—	—	—	—	—	—	—	85 (3)	9,175	8	1,281	703 (9)	42,559
—	—	1,985 (3)	44,933	225 (5)	17,629	—	—	46 (2)	5,539	61 (2)	4,023	—	—	8 (2)	391	241	17,212	4,685 (50)	214,194
34 (1)	1,292	12 (1)	336	—	—	—	—	165 (2)	9,749	—	—	—	—	237 (10)	11,887	211	11,512	1,465 (63)	67,530
831 (13)	45,885	861 (34)	17,606	720 (14)	17,293	21 (14)	691	60 (2)	6,080	1,364 (9)	24,154	19 (1)	1,725	1,895 (44)	81,340	1,213	38,834	10,964 (450)	426,618
5,226 (95)	252,857	7,002 (133)	168,506	3,263 (118)	109,408	689 (47)	32,208	1,350 (32)	86,438	2,341 (60)	56,310	85 (7)	5,247	5,694 (215)	238,505	6,260	341,182	62,999 (2189)	2,729,756

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

and Parts during April, 1961

Milling Machines		Presses		Sheet-metal Working Machines		Sawing Machines		Screwing and Threading Machines		Planing, Shaping and Slotting Machines		Unit Transfer Machines and Heads		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
191 (2)	8,992	95 (6)	5,647	215 (8)	5,934	—	—	—	—	—	—	—	—	285 (2)	19,809	51	6,504	1,873 (71)	106,628
808 (16)	57,390	3,081 (34)	90,769	688 (67)	32,612	504 (48)	17,268	88 (17)	6,999	421 (7)	19,344	—	—	1,084 (31)	69,345	526	47,283	12,307 (375)	665,414
374 (6)	20,979	191 (11)	6,547	132 (7)	7,955	—	—	569 (3)	33,796	—	—	—	—	2,036 (39)	64,336	540	24,532	3,913 (69)	162,638
464 (17)	33,415	96 (4)	9,975	231 (4)	6,541	5 (1)	293	5 (2)	526	—	—	—	—	909 (9)	19,654	108	28,283	3,975 (155)	297,177
1,209 (26)	62,740	2,467 (38)	73,574	582 (8)	29,858	—	—	330 (28)	13,116	2,038 (2)	44,484	3,069 (3)	338,109	1,744 (31)	177,100	1,823	209,177	19,012 (229)	1,392,879
2,255 (50)	68,964	902 (18)	17,074	324 (16)	17,957	237 (45)	6,621	63 (1)	4,980	53 (2)	7,576	—	—	724 (42)	37,825	490	24,140	8,917 (225)	367,330
5,301 (117)	252,480	6,832 (111)	203,586	2,172 (110)	100,857	746 (94)	24,182	1,055 (51)	59,417	2,512 (11)	71,404	3,069 (3)	338,109	6,782 (154)	388,069	3,538	339,919	49,997 (1,124)	2,992,066

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

Trade Publications

ELECTROMARK (G.B.), LTD., Harlequin Avenue, Great West Road, Brentford, Middlesex.—Leaflet describing the Electromark electrolytic marking equipments for metals, which are employed with stencils and are available in seven different types and sizes.

INA NEEDLE BEARINGS, LTD., Dafen, Llanelly, Carms.—Booklet of Technical Information, Series 14/2 (1961) concerned with "Ina Needle Bearings in Mechanical Handling Equipment and Construction Machines." This 24-page publication contains 38 sectional drawings showing bearing mounting arrangements for a variety of shafts, pulleys, chain wheels, rope pulleys, drums, and other components in this field. Useful notes on design are given for each application.

RAPID MAGNETIC, LTD., Lombard Street, Birimingham, 12.—Leaflet giving details of the Andox range of permanent magnetic pulleys for the removal of tramp iron from materials carried by belt conveyors. These pulleys are available in diameters from 12 to 24 in., and with two magnetic intensities.

Machine Tool Share Market

Business in stock markets remained at a low level during the period under review, and the general trend was for prices to drift to lower levels in nearly all sections, due to the effects of the international situation.

British Government stocks and similar gilt-edged issues held quietly steady for the most part, but finished with a slight setback in values.

Commercial and industrial share markets were subdued and mainly dull. Apart from a few firm features on selective buying, the majority of changes were easier on balance.

Among machine tool issues Edgar Allen lost 1s. 3d. at 32s. 3d.; Chas. Churchill, 3d. at 9s. 1½d.; Geo. Cohen, 3d. at 10s. 9d.; Greenwood & Batley, 1s. 6d. at 16s. 3d.; and W. E. Sykes "B," 1s. at 24s. 7½d. On the other hand, Arnott & Harrison advanced 3d. to 10s. 6d.; Coventry Gauge & Tool, 6d. to 28s. 10½d.; Craven Bros. (Manchester), 3d. to 8s. 4½d.; John Harper, 4½d. to 6s. 10½d.; Alfred Herbert, 1s. to 67s. 6d.; John Holroyd "B," 1s. 3d. to 16s. 3d.; and Samuel Osborn, 3d. to 48s.

CLARKSON (ENGINEERS), LTD.—Interim dividend of 7½ per cent.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	1/6xd
Allen (Edgar) & Co., Ltd.	Ord.	£1	32/3
" "	5% Prf.	£1	13/6*
Arnott & Harrison, Ltd.	Ord.	4/-	10/6
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	9/-
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd.	Ord.	10/-	21/-
" " "	5% Cum. "A" Prf.	£1	13/-
" " "	6% Cum. "B" Prf.	£1	16/-
" " "	4% 1st Mort. Deb.	Stk.	98½
British Oxygen Co., Ltd.	Ord.	5/-	18/6
" " "	6% Cum. Prf.	£1	18/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	8/3
Broom & Wade, Ltd.	Ord.	5/-	26/6
" "	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	15/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	15/-
" " "	5% Cum. Prf.	£1	12/6
Churchill (Charles) & Co., Ltd.	Ord.	2/-	9/1½
" " "	6% Cum. Prf.	£1	25/7½‡
Clarkson (Engrs.), Ltd.	Ord.	1/-	6/3
Cohen (George), 600 Group, Ltd.	Ord.	5/-	10/9xd
" " "	4½% Cum. Prf.	£1	11/6xd
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	28/10½
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/4½
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/6
" "	4½% Red. Cum. Prf.	£1	12/-
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	10/-
Greenwood & Batley, Ltd.	Ord.	10/-	16/3
Harper (John) & Co., Ltd.	Ord.	5/-	6/10½
" " "	4½% Red. Cum. Prf.	£1	10/-
Herbert (Alfred), Ltd.	Ord.	£1	67/6
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	20/-
" "	"B" Ord.	5/-	16/3
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	25/6xd
" " "	7% Cum. Prf.	5/-	4/9
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	8/9
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	21/3
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	8/9
Macreadys Metal Co., Ltd.	Ord.	5/-	15/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	10/6
Newall Engineering Co., Ltd.	Ord.	2/-	7/-
Newman Industries, Ltd	Ord.	2/-	7/-
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	5/9
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	8/-
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	48/-
" " "	5½% Cum. Prf.	£1	22/3
Pratt (F.) Engineering Corporation, Ltd.	Ord.	5/-	16/3
Sanderson Kayser, Ltd.	Ord.	10/-	32/6
" "	6½% Cum. Prf.	£1	16/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	8/6
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	56/10½
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	15/1½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	19/-
" " "	5% Cum. Prf.	£1	13/3
Stedall & Co., Ltd.	Ord.	5/-	7/6
Sykes (W. E.), Ltd.	"B" non-voting Ord.	10/-	24/7½xd
Tap & Die Corporation, Ltd.	Ord.	5/-	15/6xd
" " "	4½% Deb. 1961-1977	Stk.	81½
Wadkin, Ltd.	Ord.	10/-	26/-
Ward (Thos. W.), Ltd.	Ord.	£1	72/6
" "	5% Cum. 1st Pref.	£1	13/6
" "	5% Cum. 2nd Pref.	£1	20/-
Willson Lathes, Ltd	Ord.	1/-	3/-

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

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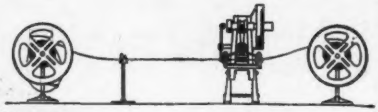

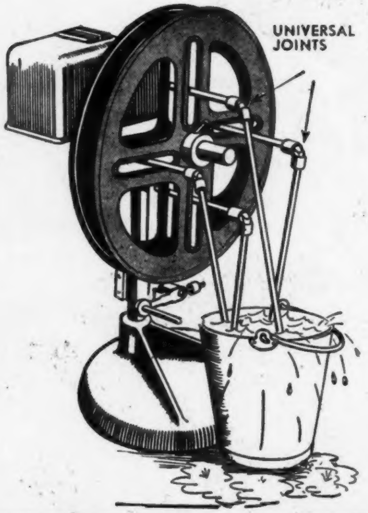

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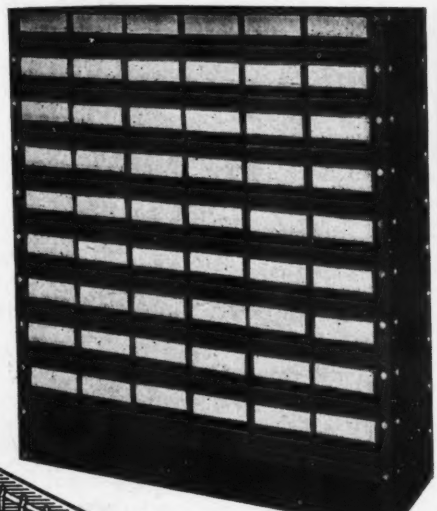

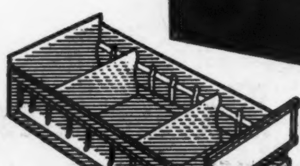

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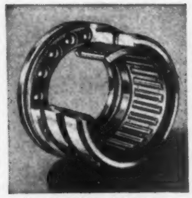
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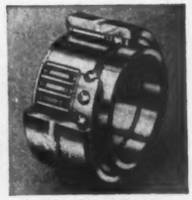
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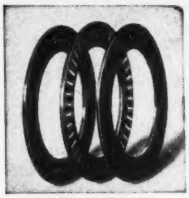
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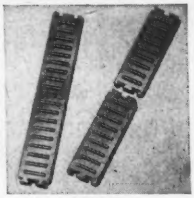
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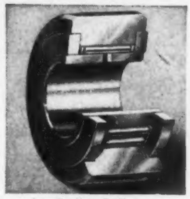
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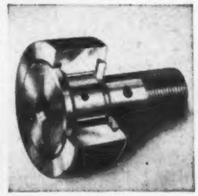
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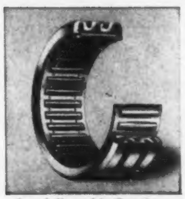
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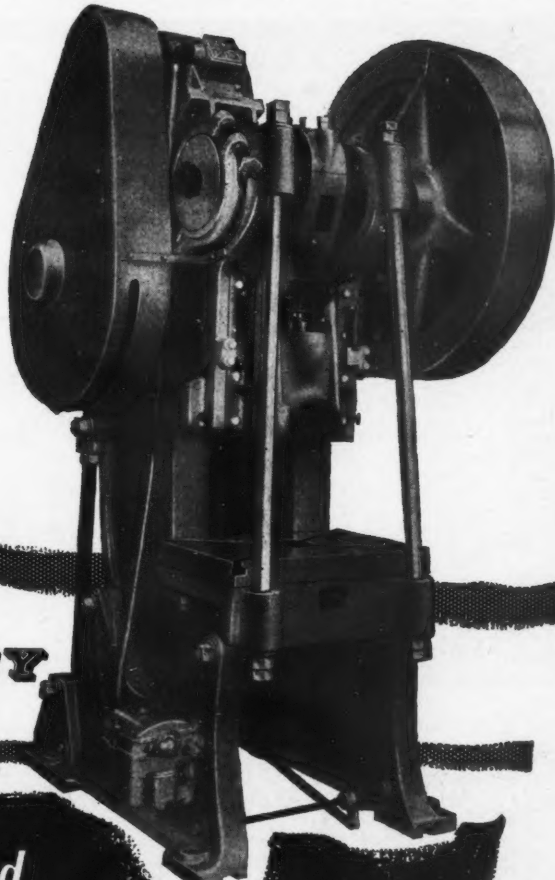

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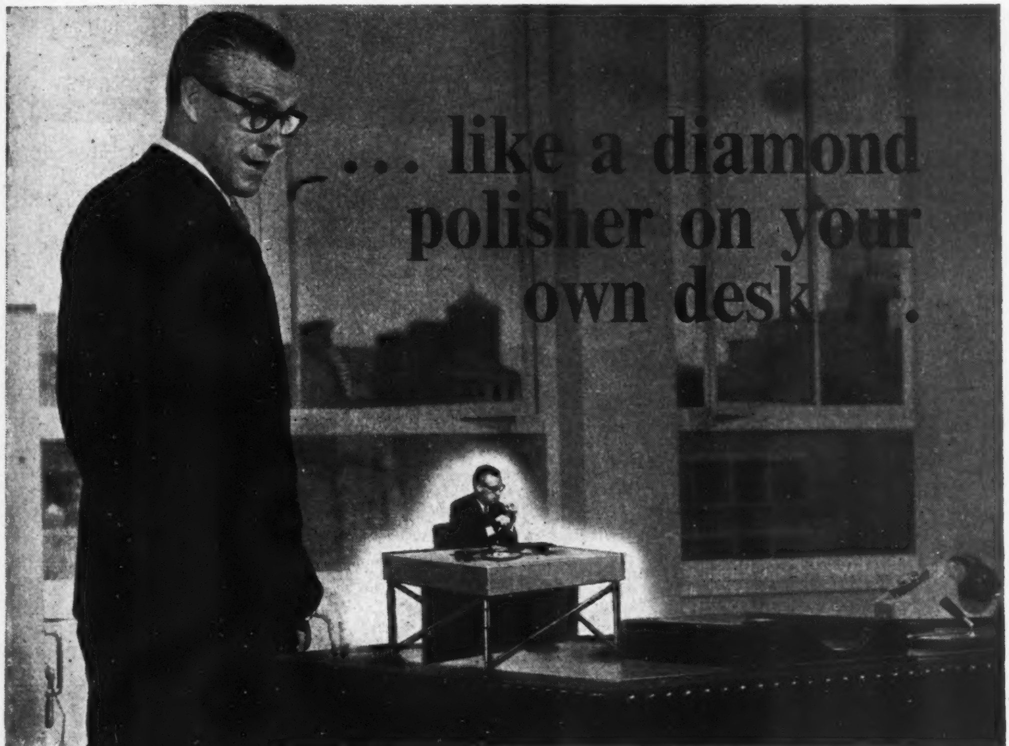

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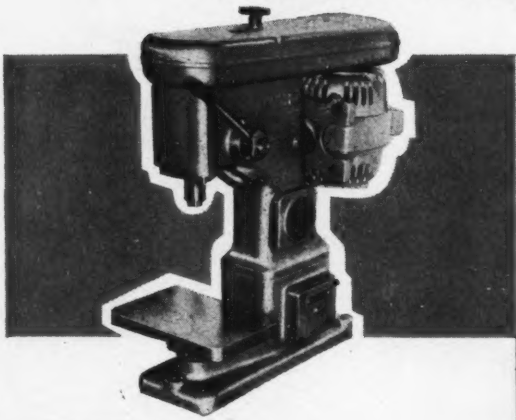

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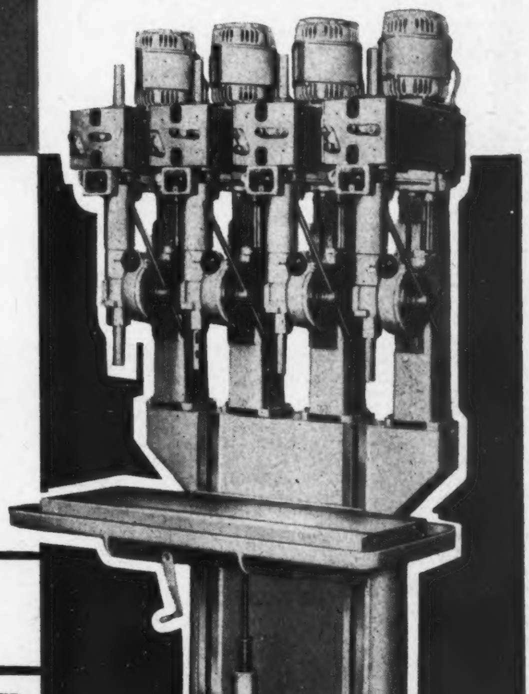

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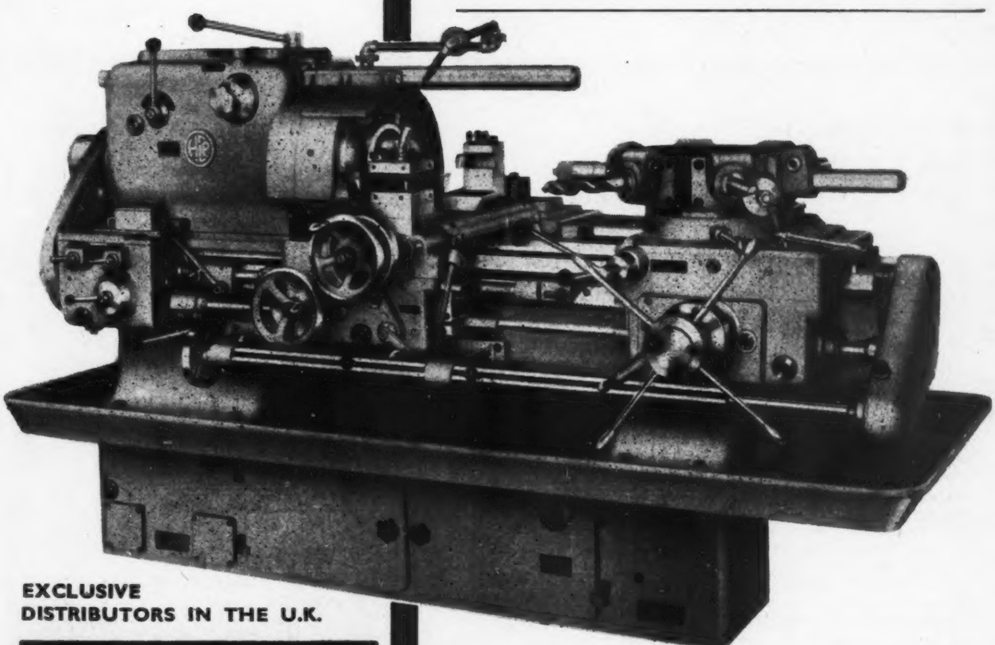

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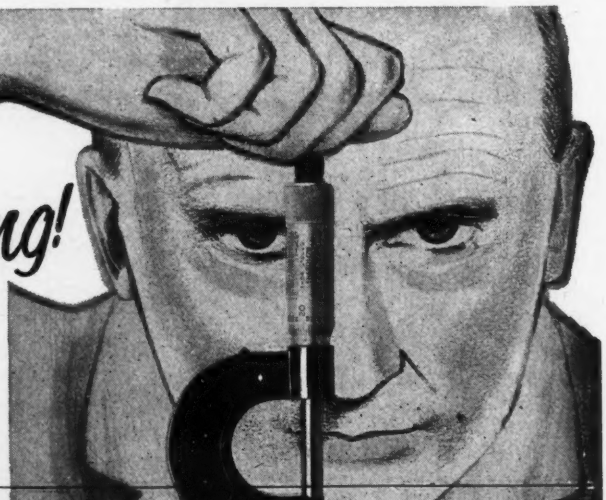

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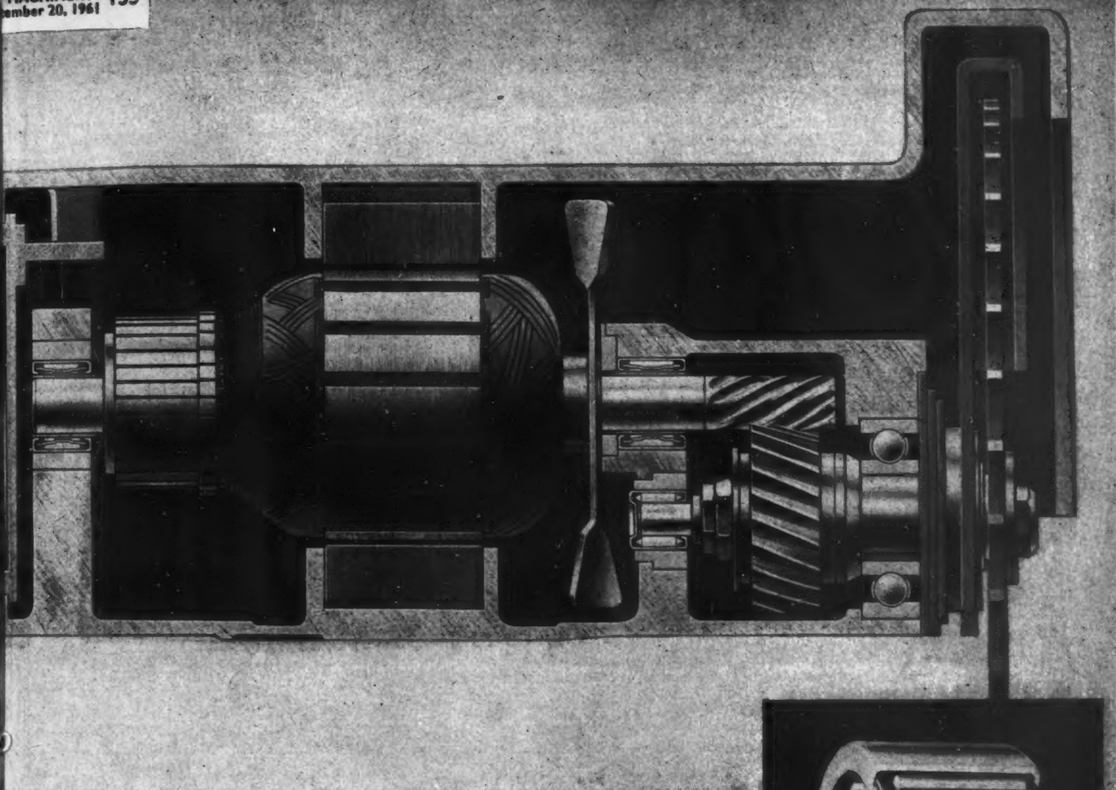

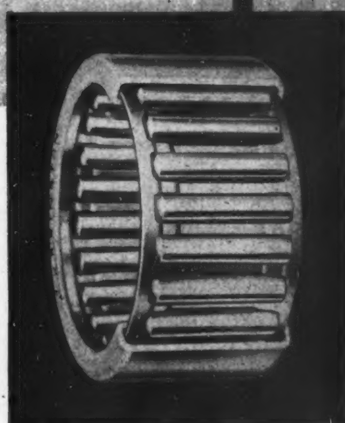

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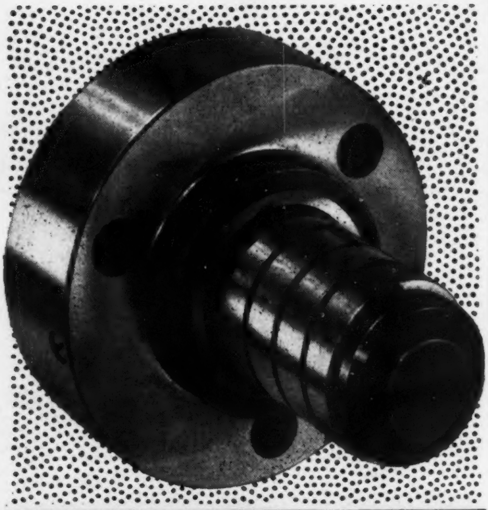

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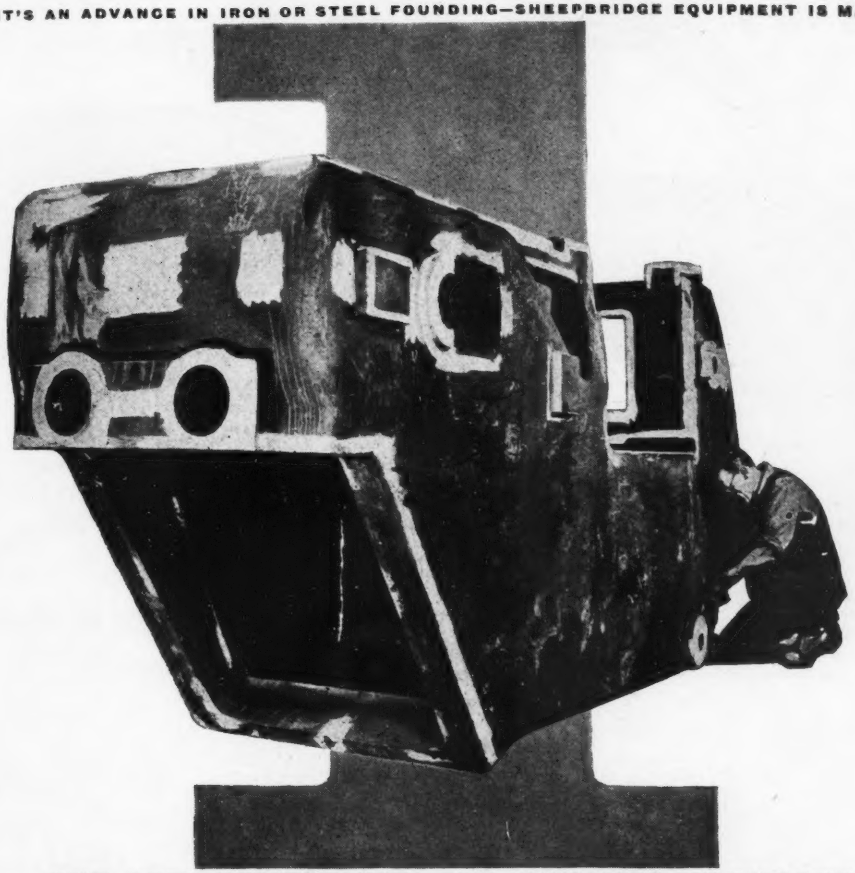

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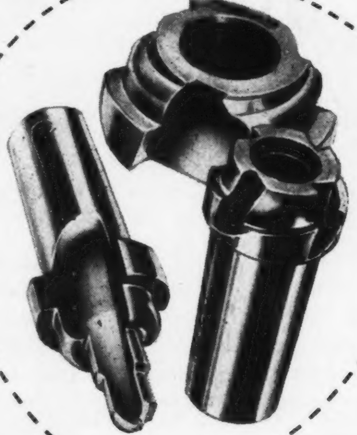

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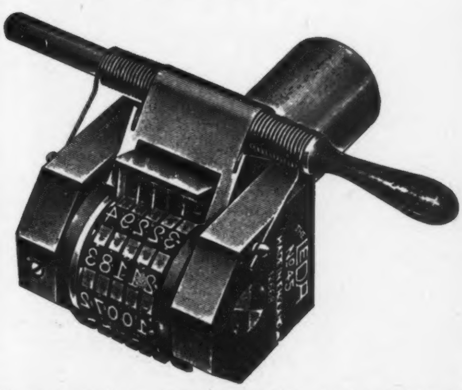

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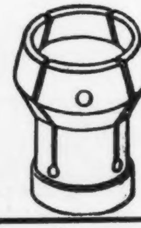

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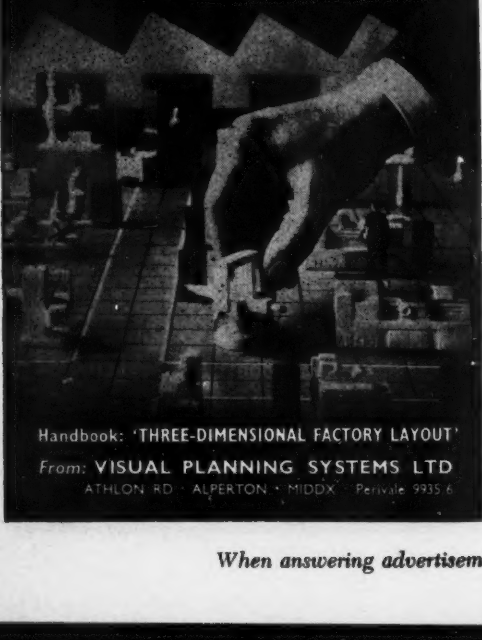

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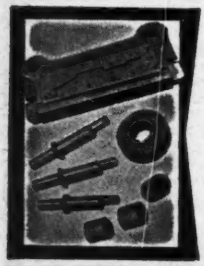


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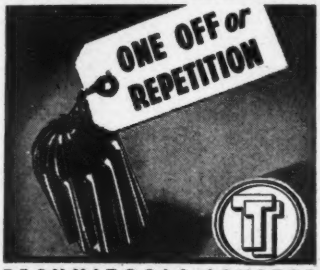

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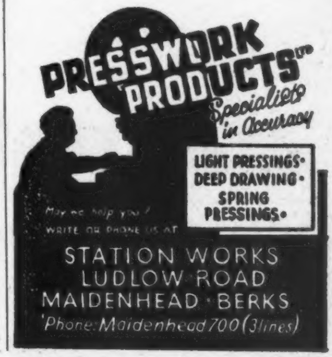

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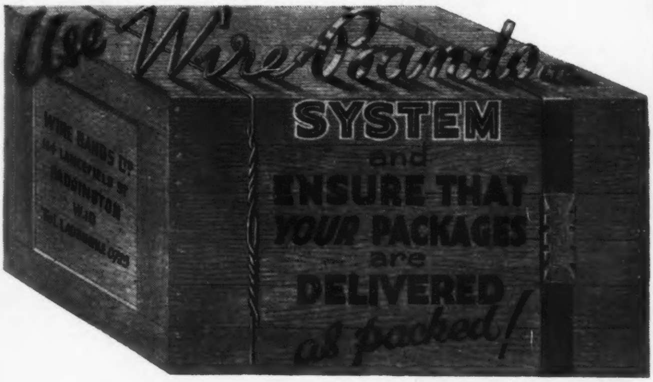

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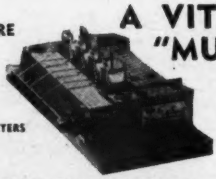

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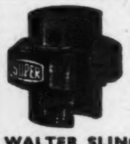

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Pels Punch Shears and Cropper, 12in. blade, shear ¾in. takes 6in. × 6in. × ⅝in. angles.

Robertson Shears, ½in. capacity, 10 h.p. 28in. blade, 9in. maximum opening. (Two.)

Berry Plate Guillotine, capacity 4ft. × 1in. 18in. throat, 30 h.p. motor.

New 1-cwt. and 2-cwt. Hammers by Massey and Alldays & Onions, also 3-5-cwt. secondhand E.O.T. Cranes.

30 Ton Marshall Fleming, 29ft. span, cab control.

25 Ton Clyde, 21ft. 9in. span, cab control 1954. Can convert any span to 95ft.

20 Ton Vaughan 42ft. 3in. span. Unused.

20 Ton Morris Goliath 35ft. span, 5 ton auxiliary.

10 Ton Heywood, 34ft. span. Unused.

10 Ton Morris 32ft. 10in. span, cab control

10 Ton, 60ft. span. 1955. (Two.)

5 Ton, 37ft. span. 1944.

3 Ton Morris, 149ft. span. 1954.

FRED WATKINS (ENGINEERING), LTD., Coleford, Glos. 'Phone: Coleford 2271 (5 lines).

ACBARS

AVAILABLE FROM STOCK

AUTOMATICS

B.S.A. Acme Gridley ⅞in. 6 spindle. Rebuilt machine.
CONOMATIC 1¼in. 4 and 6 spindle. Rebuilt machines.
RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

BORER

KEARNS No. 1 Patent.

BROACH

FORST RIAS Universal Vertical Broach for internal and surface broaching. 5 tons, 39⅜in. stroke. 1952 machine.

GRINDERS

PALLAS No. 2 Surface 18in. × 6in.
BROWN & SHARPE No. 2 Surface.
New ALPA Surface, 32 × 8in.
ABRASIVE 3B Surface 24in. × 8in.
JUNG AS Internal.
KEIGHLEY Type XL Hydraulic Plain Grinder, 6in. × 18in.
CHURCHILL 10in. × 24in. Universal.
LANDIS 12 × 48 Universal.
BROWN & SHARPE No. 3 Universal.
NORTON 14in. × 36in. Universal.

CAPSTAN AND TURRET LATHES

MURAD 3Q ⅝in. Capstan.
HERBERT 2S Bar Feed Capstan.
GISHOLT No. 5 Bar Feed Capstan.
LIECHTI PR Turret Lathe (Swiss).
GISHOLT Turret Lathes, Type 1L.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

HENDEY 6in. × 30in. Taper Turning.
MONDIALE 7in. × 60in. Gap Bed.
CROMWELL 3½in. Precision.

MILLERS

RICHMOND 01 Universal.
HERBERT No. 1 Hand Lever. Rebuilt.
ADCOCK & SHIPLEY Model OA with "Multiform" Auto. feed. Rebuilt.
WERNER No. 5160 Small Multipurpose. Vert. and Horiz. Table 22in. × 6¼in.
ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
EDGWICK 18in. Horizontal.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. × 10in.
BROWN & SHARPE No. 2 Light Type Horizontal.
KENT-OWENS 1-8 and 1-14 Hydraulic Production.
OLIVETTI FP2 Production—Unused.
CINCINNATI 3-24 Plain Hydromatic.
CINCINNATI 4-36 Duplex Hydromatic.
New TAYLOR Vertical, table 17¾in. × 5½in.
HERBERT 23V Vert. Table 68in. × 17in. 48in. traverse.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

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V. & O. No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

ACBARS LIMITED,
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8in. Centre "Reed-Prentice" m/d all-geared S.S. & S.C. Lathe. Admits 4ft. 6in. b.c., 16 speeds 18-536 r.p.m. Spindle bored 1$\frac{15}{16}$in. dia. mounted in "Timken" roller bearings. Norton type gearbox.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone: 84246.

American First Class Machines of all types can be supplied from our American Showrooms. Send your enquiries to K & C MACHINERY, LTD., Stephen Street, Coventry. Telephone: Coventry 23669.

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1956 CHURCHILL CYLINDRICAL GRINDER 'AS NEW'

Capacity	...	16in. × 144in.
Between Centres	...	12ft. 6in.
Height of Centres	...	8¾in.
Wheel size	...	30in. × 3in.
Capacity using steadies: ...	...	12in. dia. × 144i
Table	...	12in. × 15ft.
Table Swivels	...	4 each way.
Motorised ...	...	400/3/50.

For further details and photograph

STANCROFT LTD.,
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'Phone 25661.

Herbert No. 5 Chucking Autos—capacities 32in. and 20 in. swing—good condition—Serial Nos. ET 1582 and ET 812.—C. DUGARD, LTD., Denmark Villas, Hove 32471.

Bryant No. 24-36 Hydraulic Internal Grinder, complete with Hydraulic Wheel Dressing device, Spindle, etc.

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DALSTON JUNCTION,
LONDON, E.8.
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CARDIFF 7in. S.S.S.C. Centre Lathe, 3 and 4 Jaw Chucks, Suds Pump, etc. 400/3/50. £375.

SMART & BROWN 4in. Precision Lathe with 4 Jaw Chuck, Collets, etc., on Cabinet Stand, 400/3/50. £75.

AMERICAN Tool Works Lathe 9in. × 4ft. 6in. with 4 Jaw Chuck, Motorised 400/3/50. £150.

REDMAN CHURCHILL 7in. Production Lathe, 2¾in. Hollow Mandrel, 32in. between Centres, Motorised 400/3/50. £235.

SOUTHBEND 4½in. Centre Lathe on Stand, Motorised 400/3/50. 3 Jaw Chuck, etc. £50. Bench ditto £45.

5½in. × 6ft. Centre Lathe, Belt Drive, 3 Jaw Chuck, Taper Turning and Change-wheels. £45.

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Thiel No. 3 Filing and Sawing Machine. Incorporating bandsaw and brazing attachment. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

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Our stock includes Myford MG12 Grinders, Eagle Surface Grinders, Myford Lathes, Boxford AUD 4½in. Lathes, Willson 6½in. Lathes, Pacera Drilling Machines from ¼in. to 1¼in. capacity, Startrite Bandsaws, Kennedy, Rapidor and Q. & S. Hacksaw Machines, Centec Milling Machines, 18in. Alba Shapers, Vices and Rotary Tables of all types.

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NAVALMECCANICA
13ft. by 5ft. by 4ft. Planing Machine,
three tool boxes, brand new
ex manufacturer. Quick delivery.

'UNION' BFT. 63
Horizontal Boring and Facing
Machine, 2½in. dia. spindle,
Speeds 4 to 1,400 r.p.m.

ARCHDALE
5ft. Heavy Duty Low Base
Radial Drilling Machine.
Nearly New

KENDALL & GENT.
Plano Milling Machine,
with Vertical Head,
4ft. by 4ft. by 4ft. long,
Speeds 12 to 700 r.p.m.

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Canal Street Works, Nottingham · Telephone : 51891 (4 lines)
MEMBER OF B.A.M.T.M.

Classified Advertisements (PLANT FOR SALE, contd.)

F. J. Edwards Ltd

No. 12 **RYDERMATIC** three slide Vertical Multi-tool Lathe, maximum swing 20in., maximum length 16in., vertical slide stroke 8in., horizontal slide stroke 5¼in.
HERBERT No. 5 Auto Chucking Lathe, swing 18½in. over bed. 3¾in. hollow spindle.

TAPPING MACHINES
JONES & SHIPMAN "Electrotap" Vertical Tapping Machine, leadscrew control with auto cycle for depth, reverse and stop, 1½in. stroke, 200 r.p.m.
HERBERT ⅜in. No. 1 Flashtapper.

BORING MACHINES
EMTOC Jig Boring Machine, table 27in. × 11in.; spindle No. 2 Morse Taper, 350 to 3,500 r.p.m.
WEBSTER & BENNETT 36in. Vertical Boring Mill with Murray colour control, 6.5 to 124 r.p.m.
GIDDINGS & LEWIS No. 0 Horizontal Boring Milling and Drilling Machine, spindle 3½in. dia.
New High Grade Swedish Horizontal Boring and Milling Machines. Model AV 75. 3in. dia. traversing spindle, 28in. capacity facing head. Stock delivery from London. SOLE BRITISH AGENTS.
KEARNS Size OB Horizontal Boring Machine, covered bed, screw cutting motion. 2½in. traversing spindle.
PADDON Vertical Cylinder Borer for automobile cylinders, 2.2in. to 5.5 in. dia.; boring depth 14in.

DRILLING MACHINES
NEW 3ft. Radial Drilling Machines, No. 4 Morse Taper, swivel table, 500 r.p.m.
AMERICAN TOOLWORKS 3ft. 6in. Radial Drilling Machine, No. 4 Morse Taper; speeds 93.2,000.
NEW **TOWN** 4ft. 6in. model AE4 Elevating Arm Radial Drilling Machine. No. 5 Morse Taper.
TOWN 5ft. Radial Drilling and Tapping Machine. Model C.1; spindle No. 5 M.T. Drilling capacity 3in. Tapping capacity 2in.
TOWN 8ft. Non elevating arm Radial Drill, with box bed, 122-790 r.p.m. No. 5 Morse Taper.
LELAND-GIFFORD 3-spindle Drilling Machine on 4-spindle base, with 4-speed direct mounted motors, No. 3 Morse Taper.
JONES & SHIPMAN ½in. 4-spindle Drilling Machine, separate pole change motors.
ARCHDALE and **POLLARD** No. 3, 4 and 5 Morse Taper Production Drilling Machines.
NEW Heavy Duty Production Drilling Machines, No. 5 Morse Taper; hydraulic feed to spindle and table.
HERBERT Type C Pedestal Drilling Machine. No. 3 Morse Taper, 230 volts, single phase. Auto spindle feed; flange mounted motor.

GEAR SHAPING MACHINES
BARBER COLMAN 12in. Gear Hobber.
FELLOWS No. 645A3 Gear Shaper, capacity 18in. × 3in.
FELLOWS No. 6 and 612 Gear Shapers; 35in. × 5in. capacity.
FELLOWS No. 61A Gear Shaper. 18in. × 5in. capacity.

GRINDING MACHINES
CINCINNATI 12in. × 48in. Universal Grinder.
NEW 3½in. × 14in. Universal Grinders.
MATRIX 1A Universal Grinder, 9in. × 24in.
CHURCHILL 12in. × 36in. Hydraulic Universal Grinder.
CHURCHILL 16in. × 50in. Universal Tool and Cutter Grinder.
LUMSDEN 18in. × 6in. Horizontal Surface Grinder.
NEW 24in. × 8in. Hydraulic horizontal spindle Surface Grinders.
PRATT & WHITNEY 36in. × 12in. Vertical Spindle Surface Grinder.
NORTON 36in. × 10in. Horizontal Spindle Production Surface Grinder.
GRAND RAPIDS No. 25 Hydraulic Horizontal Spindle Surface Grinder, 18in. × 6in. table. 20in. table traverse.
RIVETT No. 104 Internal Grinder, 8in. swing.
BRYANT 16-38in. Internal Grinder, max. swing without guard 38in.

359-361, EUSTON RD., LONDON, N.W.1
Telephone: EUSton 5000 Telex No. 24264

And at Lansdowne House, 41, Water St., Birmingham, 3. *Telephone: Central 7606-8*

DIMCO

54in. × 16in. **RICHARDS** Keyway Slotter.
59in. × 16in. **CRAVEN** Victoria Milling Machine.
New 60 Ton **DIMCO** Open Fronted Inclinable Adjustable Stroke Power Press.
New 42in. × 10in. **DIMCO** Model CM60 Universal Milling Machine. Power feeds and rapids.
New 10in. × 18in. **GER** Model 450 Hydraulic Universal Grinding Machines.
2A **MINGANTI** Capstan Lathe.
55in. × 13in. **CRAVEN** Universal Milling Machine.
35in. × 10in. **FRITZ WERNER** Production Milling Machine.
New 51in. × 11½in. **LAGUN** Universal Milling Machine. Power feeds and rapids.
New 40in. × 11in. **DIMCO** Model FV2 Vertical Milling Machine. Power feeds and rapids.
No. 3 **GISHOLT** Bar Feed Capstan Lathe, with equipment.
No. 2 **WARNER & SWASEY** Capstan Lathe. Chucking.
43in. × 12in. **FRITZ WERNER** Vertical Miller. Swivelling head.
20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 60-1,230 r.p.m.
20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 30-615 r.p.m.
No. 3 **KITCHEN & WADE** Honer.
No. 2 **KITCHEN & WADE** Honer.
11in./16in. **NOBLE & LUND** Hydraulic Cold Saw with Hydraulic clamp.
Model HBY **CHURCHILL** Electric Grinder.
14in. **BUTLER** Slotter. Power revolving table.
No. 3 **RICHARDS** Horizontal Borer Model PRT3.
No. 3 **KEARNS** Horizontal Borer.
No. 2 **KEARNS** Horizontal Borer.
16in. **CRAVEN** Lathe, 20ft. between centres.
54in. × 15in. **CRAVEN** Universal Milling Machine.
HERBERT S.E. Capstan Lathe.
CRAVEN Worm Milling Machines.
No. 4 **HERBERT** Capstan Lathe, arranged for chucking, complete equipment, approx. 5 years old.
8½in. × 6ft. 6in. **STANLEY** S.S. & S.C. Lathe, 6 years old.
BROWN & SHARPE 12 × 18 Hydraulic Plain Grinder for plunge grinding.
V2 **VICTORIA** Vertical Milling Machine.
No. 48 **B.S.A.** Single Spindle Automatic, ⅞in. capacity.
2A **WARD** Bar Feed Capstan, complete with equipment.

DIMCO (Gt. Britain) LTD.,
28, WOOD LANE,
SHEPHERDS BUSH,
LONDON, W.12
SHEpherds Bush 4401/2

Churchill 18in. × 6in. Cylinder Grinder—hydraulic—well equipped—first class order—Serial No. 15330.—C. DUGARD, LTD., Denmark Villas, Hove 32471.

Fellows Gear Shaper. Type 70. 7in. dia. capacity.
Churchill Fay 8in. Automatic Lathe. Speeds 87-482 r.p.m. Overhauled. Electrics 400/3/50. ROLLS TOOLS LTD., Pyrford Road, Pyrford, Woking, Byfleet 43252.

Nassovia. Practically New Model V11 Die Sinking Machine. Serial No. 158/1952. First class condition. Price: £2,000 0s. 0d.
THOMPSON MACHINE TOOLS, LTD., Salmon Pastures Works, 270, Attercliffe Road, Sheffield 4.

Newman

AUTOMATICS
BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES
WETZEL Horizontal traversing column Floor Boring and Facing Machine, 7in. diameter travelling spindle, 45in. diameter facing head. (Two available.)
KEARNS Model OB Horizontal Boring and Facing Machine, 2½in. diameter travelling spindle (1957).
UNION Model BFT100 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle (1955).
KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.
KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.
WEBSTER & BENNETT Vertical Boring Machine, table 50in. diameter.
RICHARDS Type PRT Horizontal Floor Boring Machine, 3½in. travelling spindle, 28in. diameter facing head.

CAPSTAN AND CENTRE LATHES
CHURCHILL-REDMAN Model 13NM Heavy-Duty S.S. & S.C. Gap Bed Centre Lathe, 13in. centre height × 72in. between centres. Swing in gap 50in.
MITCHELL Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10½in. centre height × 7ft. 5in. between centres. (NEW.)
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10½in. centre height.
WARD 7B Combination Turret Lathe.
NILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height × 28ft. between centres.
U.L.R.O. Heavy Duty Centre Lathe, 16in. centre height × 30ft. between centres.

DRILLING MACHINES
HETTNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES
ORCUTT Model HM24 Hydraulic Internal Gear Grinder.
GLEASON 3in. Straight Bevel Gear Generator

GRINDING MACHINES
CRAVEN Roll Grinding Machine, capacity 20in. swing × 138in. between centres.
CHURCHILL Model HBY Internal Grinding Machine.
CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing × 84in. between centres (1951).
LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing × 18in. between centres.
ORCUTT Model HM24 Internal Spur Gear Grinding Machines.
CHURCHILL Plain Hydraulic Cylindrical Grinding Machine, 20in. swing × 72in. between centres.
BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres.

MILLING MACHINES
CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. × 22in. (1952).
CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
CINCINNATI No. 1M Vertical Milling Machine.
CINCINNATI No. 4 Dial Type Horizontal Milling Machine.
PRATT & WHITNEY Model BL3620 3-spindle "Keller" Die Sinking Machine.
CENTEC Model 3R Automatic Production Milling Machine, table 25in. × 16in.

MISCELLANEOUS
LANGE & GAILEN 28in. stroke Double Headed Hydraulic Shaping Machine.
TAYLOR & CHALLEN Double Sided 50-ton Geared Power Press, 10in. stroke.

NEWMAN INDUSTRIES LIMITED

Machine Tool Division: YATE, BRISTOL
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London Office: Terminal House, Grosvenor Gardens, S.W.1. Tel.: Sloane 8206. Telex. 23289.

Classified Advertisements (PLANT FOR SALE, contd.)

Cashmores

Selections of Machine Tools from Stock or Early Delivery

DRILLING MACHINES

ASQUITH LDR 4ft. 6in. Radial Drilling Machine No. 4 M.T. spindle.
KITCHEN & WADE 6ft. Girder Type Radial Drilling Machine, 18 spindle speeds, 6 feeds, No. 5 M.T. spindle.

BORING MACHINES

ASQUITH Floor Type Horizontal Borer, 3in. diameter travelling spindle, swivelling column with 6ft. × 5ft. tee-slotted bedplate.
WEBSTER & BENNETT Series D 36in. Single Column Type Vertical Boring Mill.

SLOTTING MACHINE

ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table.

LATHES

COLCHESTER 8½in. Mascot S.S. & S.C. Gap Bed Lathes, to admit 6ft. 6in. between centres.
CRAVEN 15in. S.S. & S.C. Lathe, to admit 10ft. between centres.
DEAN, SMITH & GRACE Surfacing and Boring Lathe, with hexagon turret, swing over bed 24in., swing in gap 36in.
CRAVEN 15in. S.S. & S.C. Lathe, to admit 25ft. between centres. Two saddles.

MILLING MACHINES

MILWAUKEE Model 2K Heavy Duty Dial Type Vertical Milling Machine, working surface of table 56in. × 12in.
ST. ANDRE Horizontal type Heavy Duty Plain Milling Machine, table size 73in. × 16½in.
VICTORIA V3 Vertical Milling Machine, swivel head, power feeds and rapid traverses to table in all directions, working surface of table 60in. × 12½in.
C.V.A. "Kearney & Trecker" model 2E Dia. Type Horizontal Plain Drilling Machine, working surface of table 41in. × 12in., longitudinal feed 29in., cross feed 12in., 8 spindle speeds 25/1,000 r.p.m.
CINCINNATI Model 3/36 Hydromatic Milling Machine, table 54in. × 14in.

BROACHING MACHINE

CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. × 20in. table.

GRINDING MACHINES

JONES & SHIPMAN Fig. 540 18in. × 6in. Hydraulic Horizontal Spindle Surface Grinding Machine, with 14in. × 6in. magnetic chuck.
CHURCHILL 16in. × 36in. Model PRH Universal Grinding Machine, with hydraulic feed and internal grinding attachment.

POWER PRESS

New **BUTTERLEY** No. 4 20 Ton Ungeared Power Press, 1in.-3in. adjustable stroke.

SAWING MACHINE

NOBLE & LUND 40/48in. Cold Circular Sawing Machine, 17in. diameter rounds, 15½in. squares, 27in. × 12in. S. Beams.

SCREWING MACHINE

KENDALL & GENT 3-2 Tangential Head Screwing Machine, to screw bolts up to 2in. outside diameter, tubes up to 3in. inside diameter, machine fitted with leadscrew.

SHAPING MACHINES

HERBERT 20in. stroke Shaping Machine, 6 ram speeds.
ORMEROD 18in. stroke Shaping Machine, 9 ram speeds.
TOWN 26in. Shaping Machine, 6 ram speeds.

MISCELLANEOUS

CLYDE 10 ton Overhead Electric Travelling Crane, 52ft. 3in. span.

All the above machines are motorised 400-440/3/50 cycles

JOHN CASHMORE LTD.,
GREAT BRIDGE, STAFFS. Tel.: Tipton 2181/7.
(Also at **NEWPORT, MON**)

AUTOS

CONOMATIC 1¼in. 8-spindle Type W.W.
WICKMAN 2¼in. 5 spindle Auto. 1941 machine.

BORERS

UNION Model BFT 100/11. 4in. spindle.

DRILLING

ASQUITH 4ft. O.D.1 Radial Drill.
PROGRESS 5E Round Table.
ARCHDALE 28in. Heavy Duty Pillar Drill.
NEW—**MAS** Model V.R.2, 3ft., Elevating Arm Radial Drill.
MAS Model V.R.4, 4ft. 6in., Elevating Arm Radial Drill.

LATHES

SOUTHBEND 16in.
EDGWICK 7in.
DEAN, SMITH & GRACE. Height of centres 7in.
MONARCH 22M, S.S. Taper Turning Lathe.
WARD 10 Combination Turret Lathe.
WARD 7 Combination Turret Lathe.
LANG 10½in. Gap Bed. 5ft. between.

MILLING

28in. **ARCHDALE**, Rapid all ways.
18in. **EDGWICK** Production Mill.
CINCINNATI No. 5 High Power Plain Hor. 1942 machine.
MILWAUKEE 2 HL Vertical—rebuilt.
MILWAUKEE 2K Plain—overhauled.
MILWAUKEE 3KM Universal, metric, with dividing head.
PEGARD Bed Type Vertical, table 84in. × 29in.—slightly used.
KENDALL & GENT Model C.V.M. 25.
NEW—**GIEWONT** Model F.Y.C. 25 No. 2 Vertical Miller, 44 × 10in. table. Delivery mid-October.

GRINDING

NEW—**RIBON** Model R.V.R.1000, 10 × 40in.

SHEETMETAL

GUILLOTINES
TRIUMPH 6ft. × ⅛in. Overcrank.

All machines motorised 400/3/50

STANCROFT LTD.,
BEDWORTH ROAD, COVENTRY.
Telephone Coventry 88072/3.

Baker No. 4 and No. 5 Heavy Duty Drilling machines—good condition.—C. DUGARD, LTD., Denmark Villas, Hove 32471.

Bridges 'Copyrite' Hydraulic Copying attachment complete with pump and fittings but less template holder.—Offers and details from HUNT & CO. (BOURNEMOUTH) LTD., Engineers, Holdenhurst Road, Bournemouth.

Herbert No. 1 Horizontal Miller. Table 26in. × 8in. Power Feed. Speeds 100–530. Coolant equipment. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

New 6ft. 0in. × 3ft. 6in.; 7ft. 0in. × 4ft. 0in.; and 10ft. 0in. × 3ft. 0in. Marking Off Tables for sale. Accurately machined top face and heavily ribbed. Mounted on cast iron legs. Total height approx. 34in.—Illustrations and full details from F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1 or 41, Water Street, Birmingham, 3.

WIDDOWSONS

PENSOTTI Model KTV1050 Turret Type Single Column Vertical Boring and Turning Mill. With sidehead. To swing 43in. dia., admit 32in. under cross slides, 20 h.p. motor.

JONES & SHIPMAN Model 921 Heavy Duty Pillar Drilling and Tapping Machine. No. 5 M.T.

DEMM Model S.18-750 Gear Shaping Machine.

REINECKER Model SSM3 10ft. Heavy Duty External and Internal Spur Gear Shaping Machine. 6¾in. face width.

ALFRED HERBERT No. 9a Heavy Duty Combination Turret Lathe, 20½in. swing over bed, with taper turning attachment, spindle speeds 11 to 809 r.p.m., covered bed, well equipped.

KAESER (Swiss) Hydraulic Plain Cylindrical Grinding Machine. Two machines available. Capacity 6in. × 36in. and 10in. × 20in. Both in excellent condition.

CHURCHILL Model VB Slideway Grinding Machine, 72in. × 34in. × 36in. Excellent condition.

SCULFORT FOCKEDY 12in. Centres High Speed Gap Bed S.S. & S.C. Lathe, 14ft. between centres.

OLDFIELD & SCHOFIELD 32in. Swing Gap Bed S.S. & S.C. Lathe, 10ft. between centres, swing in gap 50in. × 16in. Taper turning attachment.

MITCHELL 8½in. Centres Gap Bed S.S. & S.C. Lathe. Several available. All As New. 52in., 54in. and 64in. between centres.

WARD No. 13 Combination Turret Lathe, covered bed, 25in. concentric chuck, 27in. 4-jaw independent chuck. Good turret tooling, taper turning attachment, 35 h.p. motor, 400/3/50. Modern machine. Excellent equipment.

KENDALL & GENT 4ft. × 4ft. × 4ft. Plano Milling Machine. With vertical head, 27 spindle speeds 12 to 700 r.p.m., 9 feeds to table.

CINCINNATI Hydromatic 56-72 Hydraulic Plain Horizontal Production Milling Machine. Table 103in. × 26in., speeds 24 to 179 r.p.m.

CINCINNATI Model 4HP Heavy Duty Vertical Milling Machine. Table 72in. × 19in., speeds 17 to 480 r.p.m.

ORMEROD 20in. Stroke Pedestal Type Shaping Machine. 9 speeds 9 to 104 s.p.m., 5 h.p. motor. Two machines available.

MASSEY 2-cwt. Pneumatic Power Hammers, 14in. stroke, 200 blows per minute, 10 h.p. motor.

HERBERT
WIDDOWSON
& SONS LTD.
CANAL STREET, NOTTINGHAM
'Phone: 51891

Classified Advertisements (PLANT FOR SALE, contd.)

K·E·N·T

PRESSES

Hammerle 60 ton Hydraulic Press, 14in. max. stroke, 28in. × 36in., table as new.
C.V.A. 10 ton Dieing Press.
Rhodes Incl., 25 ton.
Weingarten Incl., 30 ton.
Edwards Incl., 18 ton, Var.
Hi-ton 3 ton Hydraulic.
Edwards 4 ton, Var.

LATHES

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New Wire Straightening Machine for sale. Motorised 400/440/3/50. All steel fabricated body on four wheels, for portable use. Capacity 4 mm. to 12 mm. with 5- hardened steel guide bushes for 4, 6, 8, 10 and 12 mm. wires. Straightening speed 80 ft. per min.—Photo etc. from F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1.

Churchill plain cylindrical grinder, Hydraulic, 18in. × 6in. variable speed workhead, also Brown and Sharpe No. 5 4in. × 20in., power feeds, and Jones and Shipmen 8in. × 10in. hand feeds. Good Cond.—C. L. THOMAS LTD., Stirling Road, Solihull. Tel.: 3075-6.

Three Brown and Sharpe 00HS Autos with unidrives 6,000 revs. ½in. cap. Good condition £250 each.—SOUTH LONDON SCREW CO, Nelson Road, Sidcup, Kent.

it's ACORN 8881 for Machine Tools

USED MACHINE TOOLS EX STOCK

WARD 8 Combination Turret Lathe. Covered Bed. Good Condition. 10-800 r.p.m.

WARD 3A Ball Chuck Bar Feed and Chucking Machines. Very good selection of equipment also available with machines.

HERBERT No. 4 Capstan. Speeds up to 511 r.p.m.

LANG 8¼in. by 24in. S.S. & S.C. Lathe. 19-900 r.p.m. Spindle Bore 2¼in. 5 h.p.

LANG 10in. by 60in. S.S. & S.C. Lathe. 10-500 r.p.m. Spindle Bore 2¼in. 12½ h.p.

SWIFT Profile Copy Lathe. 18in. by 5ft. 6in. Speed Range 10-600 r.p.m. Excellent Condition.

PRATT & WHITNEY 12B Profile Mill. Twin Spindles. 225-2,880 r.p.m.

CINCINNATI No. 4 Dial Type Horizontal Milling Machine. Speed Range 18-1,300 r.p.m. Rebuilt 1961.

EDGWICK Horizontal and Vertical Mill 11in. by 46in. Table. 24-405 r.p.m. Horizontal. Vertical Milling attachment 42-680 r.p.m.

CINCINNATI 1-18 Production Mill.

KENDALL & GENT Vertical Mill. Table 19in. by 69in. Speed Range 20-300 r.p.m.

BUTLER 14in. Slotter. 6 Speeds 4in. to 14in. Stroke Table Diameter 39in. 12½ h.p.

DOWDING V 8 Gear Hobber. Capacity 8in. dia. Maximum Pitch Hobbed in one cut 14 d.p. Hob Traverse 7½in. 6-400 Teeth. Fully equipped.

CHURCHILL "HBA" Automatic Internal Grinder. Table Traverse 18in. Maximum Swing over Table 19in. Work Speeds 48-340 r.p.m.

MAGERLE F.10 Surface Grinder. 41in. by 9in. Table. Automatic Feeds. Infinitely variable on all traverses.

BROWN & SHARPE No. 13 Universal Grinder. Capacity 8in. dia. 27in. between centres.

GATE MACHINERY CO. LTD
172-178 VICTORIA ROAD · ACTON · LONDON W.3
TEL: ACORN 8881/2 TELEX: 2111

Cincinnati No. 3 Dial Type Horizontal Milling Machine complete with Universal Dividing Heads and Circular Table. Excellent condition.

Further details from:—
C. & G. OLDFIELD, LTD.
15, Abercorn Street,
PAISLEY.

Bateman 8ft. × 3ft. × 2ft. 6in. Planer—two toolboxes on cross slide—very good order—C. DUGARD, LTD., Denmark Villas, Hove 32471.

Cincinnati No. 3 Dial-type Universal Milling Machine. Table 62½in. × 15¾in., 21 speeds 18-1,300 r.p.m. With 12in. universal dividing head, vertical milling head Post-war machine, in excellent condition.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone 84246.

Krauseco Four Spindle, Upstroking, fine Borer, 400/3/50. Adjustable centres.—HICKS MACHINERY LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333

For Sale
Several BULLARD 36in. VERTICAL BORING MILLS
with side head.
LATE TYPE MACHINES
Excellent condition
F. J. Edwards Ltd.,
Edwards House, 369 Euston Rd., London, N.W.1
EUSton 5000 Telex 24264

CHURCHILL REDMAN 32¼in. Heavy Duty Shaper. 8 ram speeds 8-104 SPM. 11 Auto feeds. Table top area 32¼in. × 16in. 400/3/50.

SMITH & MILLS 26in. Heavy Duty Shaper. 8 ram speeds 8-100 SPM. 15 Auto feeds, rapid traverse, swivel base vice, 400/3/50.

ARCHDALE 28in. All Purpose Horizontal Milling Machine. Table size 38in. × 13in. Power and Rapid Power traverse all ways. Spindle speeds 30 to 462 r.p.m. 400/3/50.

ACME GRIDLEY Type RAS6 1in. Capacity 6 Spindle Automatic. Screwing and Drilling Attachments. Excellent condition. 400/3/50.

B.S.A. Type RA Gridley 1¼in. Capacity 6 Spindle Automatic. Universal threading attachment, 5th position parting off slide. Late model, extensive equipment. 400/3/50.

ALEXANDER 2A Universal Die Sinking Machine. Table size 14in. × 8in. Copy table 12¾in. × 17¾in. Ratio 1½-1 to 10-1. 10 spindle speeds 1,900 to 15,000 r.p.m. 400/3/50. Complete with equipment and Universal Cutter Grinder.

H.M.E. Type L 40 Ungeared Open Front Inclinable Power Press. Pressure 40 tons. Adjustable stroke ¼in. to 4in. Bed area 29½in. × 21½in. 400/3/50. Operator's Guards.

RUSHWORTH Geared Overcrank Power Guillotine. Capacity 10ft. × ½in. m.s. 20 Strokes per minute. Motorised 15 h.p. 400/3/50. Complete with automatic hold-down, front and rear gauges, fully guarded and spare set of blades.

RHODES No. 12 Double Sided, Double Crank, Geared, Power Press. Pressure 70 tons. Fitted fixed stroke 4in. Bed area 44in. × 42in. 400/3/50.

STANCROFT LTD.,
LANCASTER STREET, BIRMINGHAM, 4
ASTon Cross 2235.

Mitchell 8½in. S.S. & S.C. Gap Bed A.G.H. Lathe with 3in. Hollow Spindle. Speed range 30-400 r.p.m. Further details from:

C. & G OLDFIELD, LTD.
15, Abercorn Street,
PAISLEY.
Member of B.A.M.T.M.

Asquith 7ft. Heavy Duty Radial Drill. As new.—BOX D241, MACHINERY, Clifton House, Euston Road, N.W.1.

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4 only "Enots" No. AC 123 Air operated 4in. Machine Vices. Todays list £90. These vices are as new £42 10s. 0d. each.—ACORNTOOLS, 610-614, High Road, Chiswick, W.4. Tel. CHI 3416.

"Quasi-Arc" Electric Arc Welder for sale One operator, 18 K.V.A. Continuous rated, single phase, 50 cycles. 380/460 primary volts, 100 volts secondary. Continuous amps 300 maximum. With English Electric type FWC300 static type oil immersed transformer. Mounted on 4 wheels.—F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

Morris E.O.T. Crane, 3 ton cap., 46ft. span, D.C. electrics.—A. McNAMARA & CO. LTD., New Line, Bacup, Lancs. Phone: 946.

Herbert 2S capstans, fitted air operated Mono block control for chucking, power feeds (one fitted gearbox), 4-way toolposts, Inbuilt electrics, switchgear, suds.—C. L. THOMAS LTD., Stirling Road, Solihull. Tel.: 3075-6

Classified Advertisements (*PLANT FOR SALE, contd.*)

Classified Advertisements (*PLANT FOR SALE, contd.*)

Classified Advertisements (*PLANT FOR SALE, contd.*)

Warner & Swasey No. 1A Com- bination Turret Lathe, Serial No. 434730
Further details from:—
C. & G. OLDFIELD, LTD.,
15, Abercorn Street.
PAISLEY.
Member of B.A.M.T.M.

Gordon Try Ltd

MEMBER OF THE B.A.M.T.M

LATHES

BERRY 9½in. by 48in. Gap Bed.	£675.
SIMMONDS 12in. by 66in. Gap Bed.	£450.
A.T.W. 12in by 120in. Stl. Bed.	£525.
SOUTHBEND 6½in. by 36in. S. Bed.	£325.
WARD 2A Bar Capstan.	£575.
WARD 7 Comb. Turret.	£250.
HERBERT 288 Chucker.	£325.
HERBERT 4 Chucker.	£130.
HERBERT 9 Comb. Turret.	£350.
HERBERT 9 Comb. Turret. Rebuilt.	£850.
SOUTHWARK No. 2 Capstan.	£275.
NERO ⅜in. Collet Capstan.	£175.
PITTLER R.B. 36 Capstan.	£250.
ACME 4 Spindle Bar Auto.	£450.
P. & G. 5D Chuck Auto.	£425.
HERBERT 3 Chuck Auto.	£250.

MILLING MACHINES

MILWAUKEE 2K Universal.	£1,250.
DENBIGH 4C Universal.	£325.
RICHMOND O.1 Universal.	£250.
ARCHDALE 28in. Production.	£350.
CINCINNATI 1-12 Production.	£550.
P. & W. Slab Mill Prod.	£155.
CINCINNATI No. 2 Vert.	£1,450.
HERBERT 15S Vert.	£525.
HERBERT 18V Vert.	£595.
ASQUITH Profile Mill.	£450.

GRINDING MACHINES

J. & S. Tool and Cutter.	£425.
WICKMAN Auto Cutter.	£275.
HUNT No. 2 Drill.	£225.
HUNT No. 4 Drill.	£235.
ABTER 12in. Ring.	£495.
B. & S. No. 13 Universal.	£575.
NEWELL 10in. by 24in. Uni.	£750.
LANDIS 10in. by 30in. Uni.	£750.
NOVAMATIC Type B Internal	£650.

DRILLING MACHINES

K. & W. 4ft. Heavy Radial.	£625.
CINCINNATI 4 Morse.	£65.
BAUGH Radial Tapper.	£150.

THE CAUSEWAY, EGHAM
SURREY
EGHAM 4166-7

Goss & deLeeuw 6 × 6¾ Tool Rotating 4-Spindle Automatic Chucking Machine. 400/3/50. Threading attachment.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

LIBBY Model IH5 Turret Lathe. 1½in. spindle.
ADCOCK & SHIPLEY No. 2 Universal Miller. Vertical Head. Table 40in. × 40in.
LUMSDEN 90 L.E. Grinder. 24in. Magnetic Table.
RADIAL DRILL. 3ft. 6in. Arm. No. 4 M.T. Tee Slotted Box Table. Motorised

NORMAN E. POTTS (MACHINERY) LTD.
151/154, Sandy Lane, Birmingham, 12.
Tel.: Vic. 1278.

H.M.E. L70 Geared, Open Front, inclinable Power Press—70 tons pressure, adjustable stroke ⅜in. to 4⅛in., Bed area 32in. × 27in., Throat 10½in. 400/3/50

LANG 7in. Centre Lathe, 30in. between centres, 12 spindle speeds, 37 to 908 r.p.m., hole through spindle 1⅛in. dia. full screw-cutting. 400/3/50. fitted taper turning attachment.

PRECIMAX Cylindrical Plain Grinder. Capacity 8in. × 24in. Plunge feed. Coolant tank and fittings. 400/3/50.

RASKIN Type 6A 100 ton Geared, Eccentric Power Press. Adjustable stroke ⅜in. to 3⅜in. Bed area 29½in. × 23½in. 400/3/50.

C.V.A. MILWAUKEE 2E Horizontal Plain Milling Machine. Table size 52in. × 12in. Power and Rapid power to table. 8 spindle speeds 25 to 1,000 r.p.m. 400/3/50.

FROST Power Swing Beam Folding Machine, 4ft. × ⅛in. capacity. 400/3/50.

TAYLOR ⅝in. Capstan Lathe, fitted collet chuck and barfeed. 12 spindle speeds 210-2,750 r.p.m. forward and reverse, hand lever feed. 400/3/50. 1960 M/C.

VAN NORMAN No. 12 Sliding Head Milling Machine. Table size 38in. × 8in. 9 spindle speeds 70 to 1,465 r.p.m. 12 auto feeds ½in. to 14in. per minute. 400/3/50. Complete with Vertical Attachment.

BROOKES Overcrank, Double Geared Power Guillotine, capacity 4ft. × ½in. Powered work table (in two sections) 24ft. long approx. × 4ft. wide. 20 h.p. 400/3/50.

WILLSON Mark 1. 6½in. Lathe, 24in. between centres. 9 spindle speeds. 52 to 945 r.p.m., full range of screw cutting. 400/3/50.

STANCROFT LTD.,
LANCASTER STREET, BIRMINGHAM, 4
ASTon Cross 2235

FORREST

RHODES 6ft. 0in. × ¼in. Guillotine.
BENNIE 4ft. 0in. × ¼in. Bending Rolls.
LANG 22in. Boring and Facing Lathe.
ORMEROD 36in. Shaper.
REDMAN 10ft. × 4ft. × 3ft. Planer, Lancs. drive.
RICHARDS No. 1 and 2 Horiz. Borers.
DENHAM 11in. × 6ft. 6in. S.S. & S.C. Lathe.

W. FORREST & CO. LTD.,
SYLVESTER GARDENS,
SHEFFIELD, 1.
'Phone: 23314/5.

"Massey" 10-cwt. Pneumatic Hammer for sale. Overhanging type with slides. Anvil and tup set as an angle. Arranged motor drive 400/3/50. Automatic or single blow. Complete with anvil. Centre of tup to back 23in. Size of bar worked 5½in. to 10in. square. Weight 12½tons.—F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

Norton 60in. × 12in. Hor. Spindle Surface Grinder, 400/3/50, £750.—A. McNAMARA & CO. LTD., New Line, Bacup, Lancs. 'Phone: Bacup 946.

B.S.A. automatics, No. 48, capa- city ⅜in. fitted third slide, first class condition, also ⅝in. in good condition, barfeeds, gears, etc., inbuilt, 400/3/50 electrics.—C. L. THOMAS LTD., Stirling Road, Solihull. Tel.: 3075-6.

SOAG OFFER:-

USED METAL PLANERS

6ft. by 6ft. by 18ft. **LIBERTY,** 4 Tool Heads, A.C./D.C. Generator Sets. Rapid traverse motors and P.B. Control.

5ft. by 5ft. by 16ft. **ULRO,** 2 Tool Heads, A.C./D.C. Generator Set.

4ft. by 4ft. by 10ft. **LOUDON,** 3 Tool Heads, Generator Set and pendant Control.

3ft. by 2ft. 6in. by 8ft. **SWIFT-SUMMERSKILL** type 36M all electric, 3 tool heads, Solenoid tooling, 1952.

16ft. by 10ft. 6in. **SHANKS,** Horizontal and Vertical Planer (Wall Type Planer) A.C./D.C. Generator set.

FROM STOCK OR EARLY DELIVERY

Full details from:
SOAG MACHINE TOOLS LTD.
Juxon Street Lambeth,
London S.E.11.
Phone: RELiance 7201
Grams: SOTOOLSAG, LONDON, S.E.11.

One Secondhand Scrivener No. 1 Centreless Grinding Machine, maximum capacity 1½in. diameter with Plunge Feed. Hand Operated. Motorised 400-440/3/50.
C. & G. OLDFIELD, LTD.
15, Abercorn Street,
PAISLEY.

MISCELLANEOUS FOR SALE

Important French Company wishes to dispose of 400 to 500 tons of rails in excellent condition for re-use. 75 lbs. ASCE (average wear 2mm.) in lengths of 10m. 50 with connecting plates.—Address all enquiries to the Company.—PLEZ & ROLAND ET CIE, 21, en Chaplerue Metz (Moselle).

SITUATIONS VACANT

If you do not wish your reply to any Box No advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

Sales Engineer Required for Machine Tool Company in London. Must have good technical education and have served a comprehensive apprenticeship. Experience in jig and tool design essential. Ability to control correspondence in an expeditious manner of vital importance. State age, education, apprenticeship, experience, giving details of each employer, present salary and salary required.—BOX D212, MACHINERY, Clifton House, Euston Road, N.W.1.

Charge Hand for Machine Shop. Experienced precision turning and milling. Batch production.—WELWYN GARDEN 24146.

Gear Setter Required. Good rates of pay. Write or call giving age, experience and remuneration required to T. R. CREFFIELD & SONS, LTD., Lansdowne Mews, Holland Park, W.11. PARk 9010.

Sales Engineer Required With initiative and experience for the sale of U.S.A. and Continental Machine Tools and Equipment. Based on London, would have to travel throughout U.K., driving licence essential. Salary, commission, expenses and car or car allowance. State experience and salary required.—BOX D201, MACHINERY, Clifton House, Euston Road, N.W.1.

Production Manager Required for foundry in N.W. London, the essential requirements being age limit 30-40, an engineering background and ability to plan production, some knowledge of time and motion study an advantage. This appointment provides scope foreman with energy, drive and initiative. When replying please give brief details of education, experience and salary required. Our own staff have been informed of this advertisement.—BOX D208, MACHINERY, Clifton House, Euston Road, N.W.1.

Foreman Required for Small Machine Shop, North London.—Apply BOX D109, MACHINERY, Clifton House, Euston Road, N.W.1.

Foreman for Small Machine Shop, Croydon. Complete charge of estimating and production. State experience and salary required.—BOX D236, MACHINERY, Clifton House, Euston Road, N.W.1.

Works Manager required by progressive Engineering Company specialising in Hydraulic Presses, etc. Must be a fully experienced Engineer, have good administrative ability and able to control staff. First class prospects for the right man.—Apply in confidence giving full particulars and expected salary to BOX D245, MACHINERY, Clifton House, Euston Road, N.W.1.

Highly Paid, Secure and Interesting posts are always available for technically trained men. Find out how you can put some letters after your name by preparing at home on "No Pass—No Fee" terms. A.M.I.Mech.E., A.M.I.Prod.E., A.M.S.E., City and Guilds, etc. Full details of exams. and hundreds of courses in all branches of Engineering, Draughtsmanship, Management and Automation Techniques, the benefits of our Employment Dept. and unique record of 95 per cent. successes are given in "Engineering Opportunities"—a valuable 148-page Guide which will reveal many chances you are now missing.—Write for your copy today (stating subject of interest).—FREE and without obligation, B.I.E.T. (Dept. 43a), 29, Wright's Lane, London, W.8.

Top Grade Sales Engineer

REQUIRED BY COMPANY EXPANDING THEIR RANGE OF HIGH GRADE SPECIALISED MACHINE TOOLS

A thorough engineering background, initiative and ability to deal expeditiously with correspondence are essential. Preference will be given to candidate with a knowledge of German and previous sales experience.

This is an interesting position for a young and energetic man, with good prospects leading to Technical Sales Manager.

Please write fully in strictest confidence to—

The Managing Director · Embassy Machine Tool Co. Ltd., 248, Watford Way, Hendon, London, N.W.4.

CHIEF RATEFIXER to take full charge of Ratefixing Department.

RATEFIXERS with knowledge of process planning for batch production of medium/heavy engineering products. Applicants must have practical experience of estimating from drawings and setting times for machining and assembly or fabrication and welding.

GEARCUTTING FOREMAN to take charge of gearcutting section comprising Gleason bevel gearcutter, spiral bevel gear generator, Maxicut, Sunderland gearcutter and Hobbing machines.

Applications in writing to:

**Works Director
British Jeffrey-Diamond Limited
Stennard Works, Wakefield**

Young Engineer

Familiar with Modern Machine Tools and Production Methods required by a Progressive Company concentrating on highly specialised machine tools to assist with Planning and Sales. Should be capable of dealing expeditiously with correspondence and good knowledge of technical German essential. Write in confidence giving full details of qualifications and experience to:

BOX D.226, MACHINERY
Clifton House, Euston Road, N.W.1

INLAND REVENUE VALUATION OFFICE: VALUERS

Pensionable posts in offices in England and Wales and in Scotland for qualified men and women at least 24 and under 34 on 1.10.61; extension for candidates with regular Forces service or Overseas Civil Service. Vacancies are in District (Revenue and Compensation) and Area (Rating) offices and include posts for valuation of minerals, plant and machinery, and licensed property. Vacancies in Scotland are in District (Revenue and Compensation) offices only. Qualifications: Final examination of R.I.C.S., C.A. and E.A.I., or C.L.A.S., or B.A.(Cantab.) or B.Sc.(Lond.) in Estate Management. At least 4 years' professional (or mining, for valuation of minerals posts) experience. For Scottish posts experience in Scotland desirable, and qualifying examination preferably based on Scottish syllabus. For valuation of mineral posts, 1st Class Certificate of Competency (Mine Managers) acceptable as professional qualification. Starting salary from £858 (24) to £1,258 (34 or over); scale maximum £1,430. Promotion prospects.—Write CIVIL SERVICE COMMISSION, Burlington Gardens, London, W.1, for application form, quoting 149/61/87. Closing date 17th October, 1961.

SALES ENGINEER

required for small company engaged in selling a limited number of high class Continental Machine Tools. Younger man with good educational background, sound technical knowledge and preferably with previous selling experience. Opportunity for right man to attain executive position eventually. Area mainly North of England.

Write giving full details, to
**Box D238, MACHINERY,
Clifton House, Euston Rd., N.W.1**

Development Engineer Draughtsman required for progressive tool and machine manufacturing company in Stafford. The situation offers an exceptional opportunity for a forward thinking man to develop into a very senior executive.—Apply in writing to MANAGING DIRECTOR, STAFFORD TOOL & DIE CO. LTD., Gainsborough Works, St. Patrick's Place, Stafford.

Machine Tool Fitters and Machinists for interesting and progressive positions.—Enquiries to J. A. LUCK, PAYNE PRODUCTS INTERNATIONAL LTD., Buckingham Avenue, Trading Estate, Slough.

Classified Advertisements (SITUATIONS VACANT, contd.)

SALES ENGINEER

required to develop sales of mechanical handling equipment with particular application to machine tools. Good knowledge of machine tools essential and previous sales experience advantageous. New field with huge scope for expansion. Area North and Midlands.

Write giving full particulars, to

Box D237 MACHINERY, Clifton House, Euston Rd., N.W.1

Inspector required. Precision Engineering experience essential. Interesting and progressive position.—Enquiries to J. A. LUCK, PAYNE PRODUCTS INTERNATIONAL LTD., Buckingham Avenue, Trading Estate, Slough.

Planning Engineer wanted for medium sized company S.W. London area. Experience in planning varied jobs and also costing. Only experienced men need apply. Good Salary.—BOX D254, MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVES

MACHINE TOOL SALESMAN

Machine Tool Merchants and Consulting Engineers require an experienced man 25 to 35 years to operate in the Birmingham area. Applicants should have engineering background with proved ability to sell high quality used and new machine tools.

Reply stating previous experience and salary required.

BOX D.262, MACHINERY Clifton House, Euston Road, N. W.1

Representative or Agent wishing to supplement income required by Manchester Works. High rate of commission paid on orders for steel rings and all types wire forms.—BOX. D247, MACHINERY, Clifton House, Euston Road, N.W.1.

SITUATIONS WANTED

Project Engineer, 43, A.M.I.Prod.E., Mech. Diploma. First class practical experience, accustomed to originate design of Jigs, Tools, Special Purpose Machines. Comprehensive knowledge of Transfer machines, latest production methods, operation Planning, and Plant lay-out in light and medium engineering. Desires change.—BOX D240, MACHINERY, Clifton House, Euston Road, N.W.1.

Works Foreman, age 42, 28 years experience. Resident Middlesex, seeks change as Foreman or manager for Toolroom, general machine shop, production or experimental. Accustomed full control.—BOX D251, MACHINERY, Clifton House, Euston Road, N.W.1.

Production Executive in Sussex. Experienced in Auto cam design, tool design, estimating, planning, works costs, buying and administration. Long experience in light Mechanical and Electro Mechanical Industry.—BOX D249, MACHINERY, Clifton House, Euston Road, N.W.1.

Manager Wide Experience Light Precision Engineering, desires change, any area, accustomed full control, administration, toolroom, production, prototype and development depts., etc. Would welcome opportunity with expanding company.—BOX D224, MACHINERY, Clifton House, Euston Road, N.W.1.

Works Superintendent (51) seeks change. Light/medium engineering. Strong disciplinarian. Sound organiser.—BOX D253, MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVE

Technical Representative with first-class connections—industry, Government Depts., British Railways, etc.—seeks top-rate firm able to undertake sub-contract machining, sheet-metal and plastics; basis: retainer and small commission.—BOX D217, MACHINERY, Clifton House, Euston Road, N.W.1.

Plant or material wanted or to sell?
Men wanted for executive positions?
Situations required?
Work wanted for a slack department?

Then 'Phone EUSton 8441

advertisements telephoned Wednesday will be inserted the following Wednesday.

RECEIVED TOO LATE FOR CLASSIFICATION

PLANT WANTED

Urgently required—

Two Butterworth Single Spindle Auto's. ⅞in. or 1$\frac{1}{16}$in. capacity.

Quote details, price, serial number, condition, etc., to

BOX D250, MACHINERY, Clifton House, Euston Road, N.W.1

Wanted Herbert 21 Combination Turret Lathe.—Tel.: Warrington 33611.

Wanted Two Lathe Beds—Flat or Vee—11 feet long minimum. One with saddle if possible.—P & P ENGINEERING LTD., Burrfields, Copnor, Portsmouth. 'Phone; Ports. 60626.

Wanted Petermann 7 and 10 mm· Auto's. Britan Capstan.—AMBRESSEY ENG. CO. LTD., Norbury Road, Reigate 2177.

MATERIALS FOR SALE

3 tons high grade tool steel 10ft. to 12ft. long, $\frac{3}{16}$ × 2in. Also 1½ and 1inch, also fabricated mica sheets. Offers wanted.—E. J. MARTIN, 104, Queens Road, Tunbridge Wells.

BUSINESS FOR SALE

Clipper making business (Hairdressers & Animal). Est. nearly 100 years. Requires reorganising. About £2,000. All stock, tools. Equipment and vast connection. Owner would retain part interest if required.—BOX D252, MACHINERY, Clifton House, Euston Road, N.W.1.

PATENTS—TRADE MARKS

The Proprietor of British Patent No. 797302 for "Improvements in and Relating to Machines for the Manufacture of Ice Blocks" desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder.—Further particulars may be obtained from MARKS & CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.2.

MISCELLANEOUS WANTED

Albro Fillers: Two Secondhand 9 or 12 Head Fillers required for bottling spirits.—BOX D255, MACHINERY, Clifton House, Euston Road, N.W.1.

GENERAL ENG'G. • • SERVICES • •

CAPACITY AVAILABLE

Shearing up to 10ft. by ¼in. m.s. Bending up to 12ft. by ¼in. m.s. Profiling. Welding Steel and Aluminium.

SUB CONTRACTS DIVISION

ANTHONY HOISTS LTD.

Phone: VIKING 1244

Work wanted for Surface Grinder capacity 60in. × 12in. Also 4ft. Radial Drilling capacity.—Apply W. J. WOOSTER LTD., Eskdale Road, Trading Estate, Uxbridge, Middx. 'Phone Uxbridge 35838.

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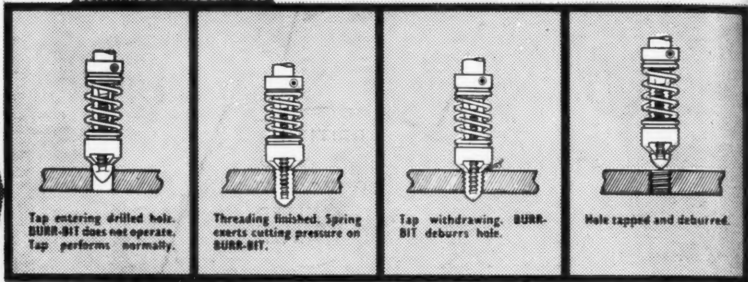

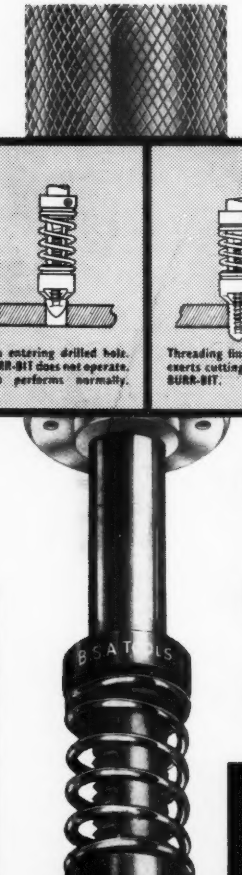

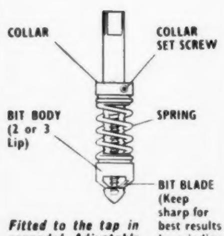

Fitted to the tap in seconds! Adjustable to suit thread depth.

For use with standard 2, 3, or 4 flute taps, on tapping machines, in tapping heads, on single and multi-spindle automatics, capstan and turret lathes.

For most materials—steel, cast iron, aluminium, brass, copper, plastics.

***SAVE** time, floorspace, manpower; BURR-BIT eliminates an extra machine, functions only as the tap is being withdrawn. No extra power is used.*

***CLEAN HOLES**—BURR-BIT chamfers while the tap is withdrawing, burr is not pushed into the hole.*

***AIDS ASSEMBLY** — BURR-BIT leaves clean thread lead. With burr removed parts are easily mated.*

B.S.A BURR-BIT

deburrs & chamfers as tap withdraws

***IN THIN MATERIAL** — more full threads are left for gripping. BURR-BIT chamfers top thread only. For deep holes BURR-BIT is furnished with double conical spring.*

***NORMAL OPERATION** — BURR-BIT does not interfere with normal tapping or the accuracy of the tap.*

Literature on request

STOCKED IN THE TAP RANGE 6BA–¼"

Patent applied for

MADE BY B.S.A. SMALL TOOLS LTD
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SOLE AGENTS U.K. BURTON GRIFFITHS & CO. LTD. MONTGOMERY ST. BIRMINGHAM 11
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